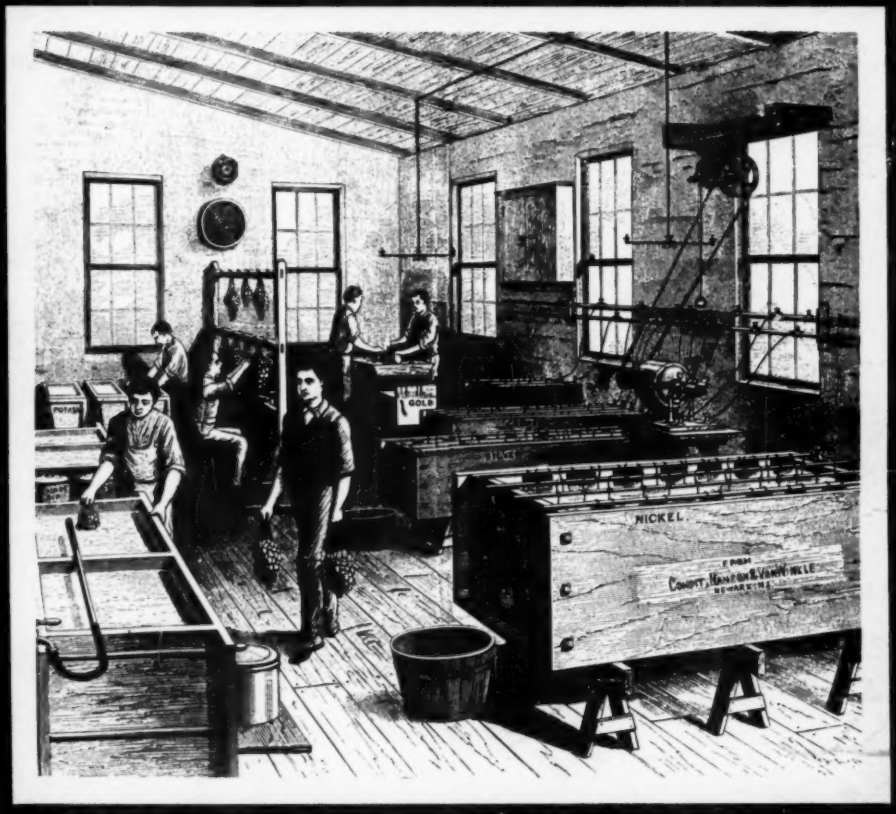
VOLUME 38
NUMBER 1

JANUARY, 1951

plating



HISTORY OF NICKEL PLATING IN U. S. A.,

See Contents Page 33

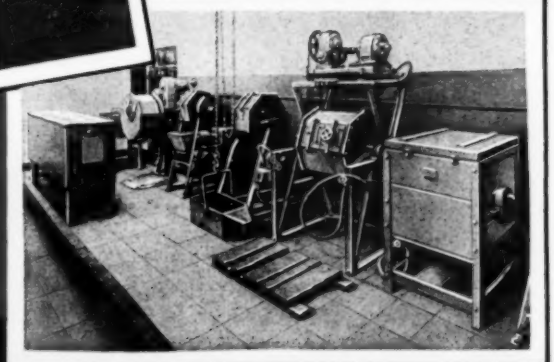
TO SERVE YOU BETTER

CLEPO *Expands its Laboratory Facilities*

FOR YOU — OF ECONOMY

FOR US — OF FRIENDSHIP

BOND



CLEPO TESTING AND SMALL PRODUCTION LABORATORY

CLEPO BARREL TUMBLING PILOT PLANT

FREDERICK **GUMM** *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N.J.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1.

Enthone announces eight new METAL FINISHING PRODUCTS

METAL STRIPPER—N165S

A new acid type stripper for dissolving nickel, tin and lead from copper base alloys without attack.

WATERSHEDDING LIQUIDS

New watershedding liquids for rapid, complete stain-free drying of metals, such as copper, brass, silver and gold.

METAL STRIPPER—A

An alkaline stripper for dissolving nickel, silver, copper, brass, zinc, cadmium and gold from steel. No electric current is necessary.

ENAMEL STRIPPER—A143

A new stripper for removing enamels from plastics and metals. Fifteen other strippers are available for stripping enamels and lacquers.

EBONOL—Z80

A simple process for blackening zinc. Operated at room temperature. Excellent heat stability. Other Ebonol processes include Ebonol—C for blackening copper and brass, Ebonol—S30 for steel and Ebonol—Z for zinc plate and zinc die castings.

CLEANER—160

A new alkali cleaner for anodic and cathodic cleaning of copper and brass, at high current density. A companion product to many other alkali cleaners for zinc, steel and aluminum.

STRIPPER—S49

A non-flammable solvent type stripper for lacquers and enamels.

EMULSION CLEANER—75S

A new solvent-emulsion type cleaner used in spray washing machines for cleaning all metals including lead and zinc.

WRITE FOR LITERATURE ON PRODUCTS DESCRIBED. ALSO CHECK LIST OF OVER 60 PRODUCTS FOR METAL FINISHING.

Enthone inc

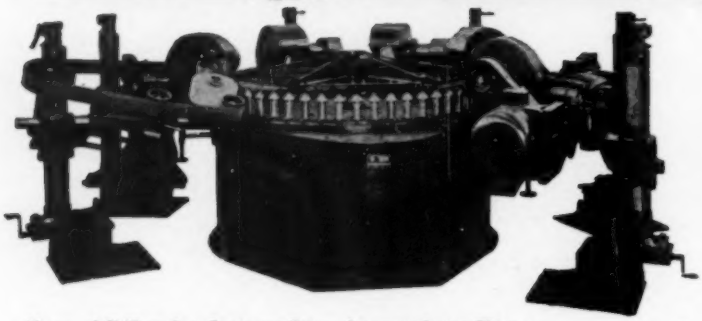
442 ELM STREET NEW HAVEN, CONN.

FOR HIGH PRODUCTION POLISHING and BUFFING

ACME Automatic

POLISHING and BUFFING MACHINES

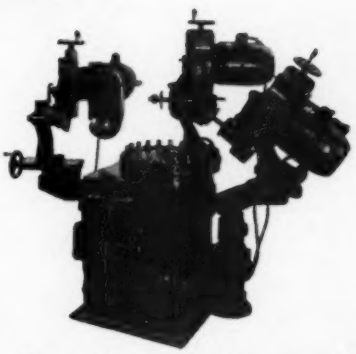
ACME CONTINUOUS ROTARIES



. . . deliver high production with uniform quality finish at low unit cost.

Above: ACME six foot Continuous Rotary Automatic having 50 continuously revolving chuck spindles. One ACME adjustable polishing belt head and five ACME adjustable floating head polishing and buffing lathes are used in this arrangement built to finish plumbing good escutcheons.

Right: ACME Type L. C. Continuous Rotary Automatic with 20 spindle continuously revolving table with variable speed control. Three ACME completely adjustable polishing and buffing lathes are used in this arrangement.



These machines can be furnished in sizes and arrangements to handle many types of parts with high output and uniformity of finish.

ROTARY STRAIGHT LINE SEMI-AUTOMATIC AND SPECIAL *Polishing and Buffing Machinery*

ACME Continuous Type Rotaries are built in table sizes from 20 inches to 10 feet or more in diameter and with a varying number and spacing of work spindles depending on piece being finished. They provide a proved solution to many production finishing problems and have earned wide recognition for their dependability and cost cutting performance.

(Catalogs on Request)

SPECIAL MACHINERY — AUTOMATIC BUFFING MACHINES

ACME Manufacturing Co.

1645 HOWARD ST. DETROIT 16, MICH.

Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR NEARLY HALF A CENTURY

Feeling the Effects of the—

Nickel Shortage?

USE 100% OF YOUR NICKEL ALLOTMENT BY CONSUMING PIECES YOU ONCE SCRAPPED

ARCO ANODE BASKETS MAKE IT POSSIBLE TO USE SWORD ENDS • BUTTS • CHIPS & SCRAPS

ARCO Anode Baskets are fabricated from heavy expanded metal, welded to ¼" diameter steel wire frames, with supporting anode hooks fabricated from ¼" x 1" band steel, and welded to a ⅛" x 1" steel reinforcing strap which runs in ONE continuous length along the sides and bottom of the basket.

Each is completely insulated with Automotive semi-hard rubber to a minimum thickness of ⅛". The tough, non-brittle rubber insulation is designed to give a long, useful life, and will withstand the cutting imposed on it by packing razor-edged metal pieces into the basket.

WRITE FOR OUR CATALOG ON OTHER RUBBER COVERED EQUIPMENT

WHEN ORDERING

Specify width and length of opening at top and depth dimension. Opening at tip is usually 2" to 6" wide, and 12" to 30" long. Depth dimension should be 2" greater than length of present anode. Hook length should be specified same as present monel hook. All sizes made to order, complete with duck filterbags.

Plating, Pickling and Chemical Processing Tanks, Racks and Hangers, Anode. Pickling and Handling Baskets. Drums, Pails, Dippers, Measures, Funnels, Pipe and Fittings. Air Agitation Systems, Grids and Screens, Ventilation Equipment, Diaphragm Systems.

AUTOMOTIVE RUBBER COMPANY, INC.

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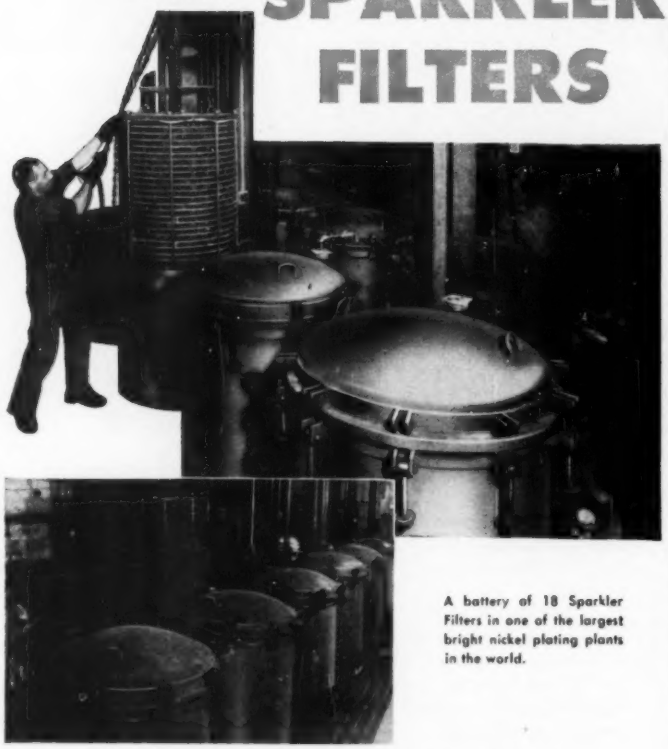
NO SHUT DOWN

To Carbon Treat Solution with SPARKLER FILTERS



A battery of 18 Sparkler Filters in one of the largest bright nickel plating plants in the world.

Carbon treatment without shut down is accomplished by cutting out one or two units in a battery of filters, removing the cartridge assembly of filter plates, and replacing with a new plate cartridge dressed with clean filter paper. The proper amount of carbon is mixed with water in a standby tank and recirculated through the filter thus depositing the carbon on the new plates in a cake of uniform thickness and density. The solution requiring a carbon treatment is then circulated through the carbon beds giving the plating solution the carbon treatment without contaminating the tank or stopping plating operations.

The quick change feature of the plate cartridge in Sparkler filters permits replacing a set of plates in a matter of minutes. Production can be resumed without appreciable interruption.

Sparkler Horizontal Plate Filters give absolutely sharp filtration at all stages of the cycle.

SPARKLER horizontal plate FILTERS

SPARKLER MANUFACTURING CO.
Mundelein, Illinois

Industry News

Nonferrous Metals Laminated. Because of increased activity in laminating and rolling nonferrous metals other than gold, the name "Gold Filled Division" of the American Silver Company, Inc., Flushing, N. Y., is now known as the Rolled Plate Division. This division is currently rolling and laminating such metals as silver, copper, beryllium-copper, brass stainless steel, for a variety of non-jewelry uses, including contct points, springs, and other uses in the atomotive, a electronic, electrical, chemicaluand aircraft industries.

Pennsalt Moves Chicago Sales Office. Pennsylvania Salt Manufacturing Company has announced the removal of its Chicago district sales office to Suite 1216, Builders Building, 228 N. La Salle Street from 20 N. Wacker Drive. The new office will be under the direction of George D. Grogan, District Sales Manager for the company's Heavy Chemicals Department, and John C. Hampson, District Sales Manager for the Special Chemicals Department.

Roto-Finish Company Expands Plant. The Roto-Finish Company, of Kalamazoo, Mich., is rapidly completing the construction of a new addition to its present plant, which will greatly increase the manufacturing facilities for Roto-Finish processing machines.

New G. E. Measurements Laboratory. The General Electric Company on October 30 officially opened its new measments laboratory in Lynn, Mass., believed to be the most modern and best equipped of its kind in the world.

The new laboratory is staffed by engineering specialists in magnetism, electricity, chemistry, metallurgy, sound, heat, light and color, and contains complete facilities for applied research, product development and design in the field of measurements. It occupies the major portion of a five-story brick, steel and concrete building containing 142,000 sq.ft of floor space. The remaining space is used by administrative staffs of the General Electric Meter and Instrument Divisions.

A special plating and inorganic-finish laboratory makes it possible to experiment with, develop and produce finishes on a pilot-plant scale. Because of the fumes from the plating process, this area is equipped with a special ventilation

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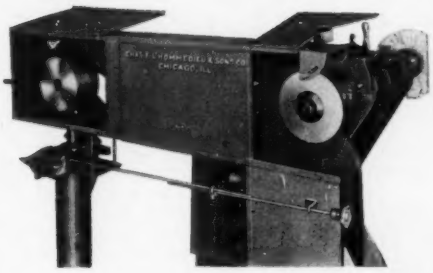
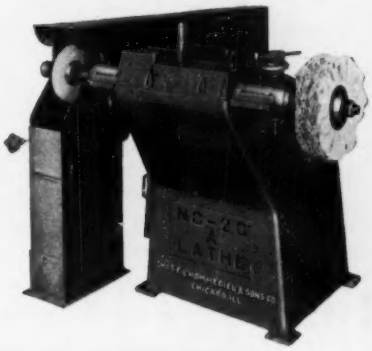
"RELIANCE"

BACK STAND IDLER

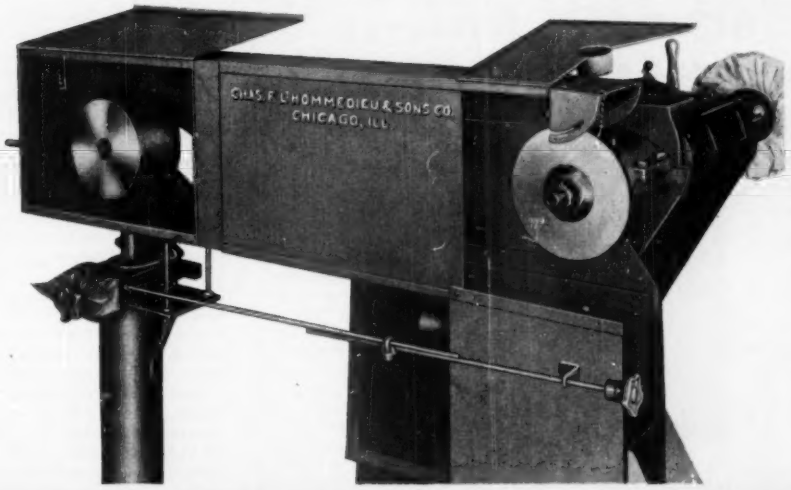


Counter weight with hydraulic shock absorber — takes up slack and provides a tension.



INTERCHANGEABLE FOR RIGHT OR LEFT HAND SIDE. ALUMINUM BALL BEARING PULLEY WITH ROTATING INNER RACE WHICH THROWS THE GREASE ON THE BALL AS IT REVOLVES. PULLEY SEALED ON BOTH SIDES SO NO DUST CAN COLLECT AROUND HUB. ADJUSTABLE FOR VARIOUS LENGTH BELTS.

Write for further particulars if you have special problems.



No shop should be without a "Reliance" BACK STAND IDLER.

Chas. F. L'Hommedieu & Sons Co.

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Plating and Polishing Machinery

Complete Plating Plants Installed

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Newark, N. J.

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Los Angeles

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system which completely changes the air 67 times an hour.

In an adjacent area, the life and suitability of various insulations and finishes are evaluated in a battery of heat-aging ovens, salt-spray and humidity chambers, "weathermometers", and "fadometers".

Additional Cyanide Production. Plans for the construction of a chemical plant at Memphis, Tenn., at an estimated cost of $7,500,000 have been announced by E. I. duPont de Nemours & Company. The plant will have complete waste control equipment, so that there will be neither water nor air pollution. It will be operated by the company's Electrochemicals Department.

James J. McIntyre, who will be manager of the new plant, already has reported to Memphis. He has been assistant manager of duPont's Niagara Falls, N. Y., plant.

Job Platers Hold Mobilization Meeting. Upon call by the National Association of Metal Finishers, a large number of job-plating-shop operators met on October 21 in the Book-Cadillac Hotel, Detroit, to discuss steps to be taken in the present emergency.

Following an opening statement by Mr. Raymond Shock, Executive Secretary, and an address by Mr. George Petrie of the Department of Commerce, reports were given of material and manpower conditions in the Philadelphia, Cleveland, Evansville, Ind., and Detroit areas by Messrs. Long, O'Berg, Miller, and Henning, respectively. President W. O. Zinn reported thefts of nickel and cadmium from Chicago shops and pointed to the necessity of keeping them securely locked up.

Perhaps most important was the recommendation made to the Office of Industry and Commerce of the Commerce Department that a survey be conducted to show the available floor space, finishes produced, and generator capacity of each individual job shop.

Waste Disposal Activities. Progress in organization of research on the disposal of such industrial wastes which contribute to pollution of the nation's water resources was reported to the National Technical Task Committee on Industrial Wastes in Cincinnati, Ohio, on November 28 and 29.

A feature of the meeting was a detailed inspection of the Environmental Health Center of the Public Health Service at Cincinnati. The work of the center, particularly its industrial waste and water pollution projects, was described by Vernon G. MacKenzie, Officer in Charge. Task groups reporting were Food Industries, Mineral Products and Chemical Processing.

Among those present were Wm. J. Neill, President of the American Electroplaters' Society.

MacDermid, Incorporated of Waterbury, Conn., announces the appointment of **Donald Sales and Manufacturing Company,** 6601 W. State St., Milwaukee 13, Wis., as exclusive distributor in Wisconsin for its complete line of metal cleaners, bright-copper and other metal-finishing preparations. Donald Sales will carry complete stocks of these materials in its Milwaukee warehouse.

T. F. O'Brien, MacDermid Sales Engineer, will be available for customer service on any metal-finishing problems.

Electric Products Appoints Kansas City, Mo., Agents. The Electric Products Company of Cleveland, Ohio has appointed the **Power Equipment Company** as its representative in the western counties of Iowa and Missouri, the Panhandle counties of Texas, and the States of Arkansas, Oklahoma and Kansas. With offices in Kansas City, Mo., Power Equipment will handle all the industrial lines of Electric Products, including synchronous and induction motors, generators, and electrolytic power supplies.

Instrument Course. The Fischer & Porter Company's next instrumentation course will be held at the Hatboro, Pa., plant January 15 through 19.

This course will cover manufacture, calibration, installation, operation and maintenance of primary and secondary process-control instruments. Users of the company's line of Flowrator instruments will find the course particularly valuable. Further details can be obtained by writing to the company.

PERMAG

POSITIVELY Removes Buffing Compounds from Metal Surfaces

- Cleaning buffing compounds from metal is the hardest, toughest job for metal finishers.
- Ordinary alkaline-type compounds do not clean satisfactorily. Solvents are too expensive and hard to handle.
- PERMAG—tested and tried in every way—cleans metal PERFECTLY from buffing compounds.
- PERMAG does the job quicker—low costing—less time and labor. That's why PERMAG is so widely used.

Write or 'phone if you've a difficult cleaning job.

Magnuson Products Corp.

Mfrs. of Specialized Cleaning Compounds for Industry

50 Court St. Brooklyn 2, N. Y.

In Canada: Canadian Permag Products Ltd., Montreal, P. Q.

Six Wyandotte Sales and Service Supervisors recently received twenty-five year service award watches. They are, left to right: Carl M. Cooper, Indianapolis; E. E. Johnson, Sioux City; A. J. Reynolds, New Haven; A. E. Nelson, New York; J. B. Holland, Toledo; J. A. Dalton, Rochester. Robert L. Reeves, General Manager of the J. B. Ford Division of Wyandotte Chemicals Corporation, at right, congratulates the new Twenty-five Year Club members. Wyandotte Chemicals to date has awarded 1570 twenty-five year watches. Of these, 1001 are worn by employees still on active duty—18.6 per cent of Wyandotte's total employees

Tin Research Institute's Director Visits United States and Canada. Dr. E. S. Hedges, Director of Research of the International Tin Research and Development Council, is on a visit to the United States and Canada. He will call upon leading research men in the metal industries and several universities to give them news of progress at the Tin Research Institute, London, England, which has been greatly enlarged.

With Dr. Hedges is Mr. W. R. Lewis, Development Manager of the Institute, who is planning to meet metallurgists in order to discuss practical problems arising in the use of tin alloys.

Dr. Hedges and Mr. Lewis make their headquarters at the associated American organization, Tin Research Institute, Inc., 492 West Sixth Avenue, Columbus, Ohio.

More Aluminum. Two hundred million pounds of increased aluminum capacity will be brought into production by Reynolds Metals Company by 1952, it was said recently by David P. Reynolds, Vice-President in charge of sales. This increased quantity of aluminum represents Reynolds' contribution toward meeting the increased military needs for the metal.

More Detergents and Surfactants. General Aniline & Film Corporation is increasing its production facilities for detergents and other surface-active agents with new construction and equipment representing an investment of more than $2,000,000. This information was disclosed by Dr. Cary R. Wagner, Vice-President in charge of Operations, at a two-day sales managers' conference called to acquaint the sales managers with the chemical products, including detergents, wetting agents and other surface active agents which are now being sold through the Antara Products Division of General Dyestuff Corporation.

Oakite Holds Technical-Sales Meetings. How recent developments in the field of cleaning and allied procedures are helping industry meet the demands of increased production was the central theme of a series of technical-sales meet-

CONSERVE METALS while you CUT COSTS

UNICHROME COATING 218X *provides rack insulation that saves on labor . . . on drag-out losses . . . on metal build-up*

This widely used green rack coating is helping in a big way to stretch metal supplies. First, since it doesn't crack or chip even after long use in all plating baths, there's no wasteful metal build-up on the rack. Second, it bakes into a smooth, glossy coating which rinses freely, thereby helping to minimize loss of valuable plating salts by drag-out.

But that's not all. You use only a single prime coat, not only saving time and labor, but also gaining longer lasting adhesion. No lifting, no formation of pockets which drag over solutions into other baths. A non-contaminating plastisol, Unichrome Coating 218X has been approved for use in leading bright nickels.

A U.C. Service Engineer will gladly help you on application procedure—show you how to get maximum protection. Ask us also about nearby applicators who can do the job for you.

UNICHROME Trade Mark COATINGS for METALS

Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Products of UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y. • Detroit 20, Mich. • Waterbury 20, Conn. • Chicago 4, Ill.
Los Angeles 13, Calif. • In Canada: United Chromium Limited, Toronto, Ont.

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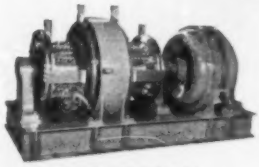
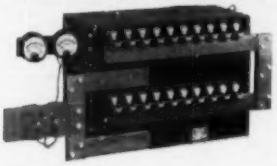
COLUMBIA



MOTOR GENERATORS
for Electroplating Anodizing,
Electrocleaning, Electropolishing



- TANK RHEOSTATS
- REVERSING SWITCHES
- TONG TEST AMMETERS

Write for Descriptive Bulletins

COLUMBIA ELECTRIC MFG. CO.
4533 HAMILTON AVE. • CLEVELAND 14, OHIO

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THERE IS NO SUBSTITUTE
FOR *Experience*

DETROIT
GREASELESS COMPOUND
The perfection of this product is the direct result of more than 25 years of experience gained in manufacturing many millions of pounds of polishing compounds and other quality-controlled abrasive materials for the production lines of the Automotive Industry and its many suppliers in the field of Metal Finishing. We sincerely believe it to be the best product for the purpose on the market today.
C. H. McALEER, President.

WE KNOW A TEST WILL PROVE

INCREASED PRODUCTION—Scientific "know-how" of the blending of abrasive grains and binders and proper selection of the compound suited for the job gives you the most uniform finish and increases speed of production.

ECONOMY IN USE—The improved and more durable binder gives ideal adhesion to the wheel; drying time and less "off the wheel" wastage.

IMPROVED CONTAINER—Our aluminum-foil container is almost impervious to moisture-loss and when properly stored will remain in good condition for a year.

LABORATORY CONTROL—Constant laboratory control of all raw materials used and experienced supervision of manufacturing processes is maintained at all times.

DETROIT
One of America's Famous Chemical Trademarks
DETROIT CHEMICAL SPECIALTIES CO.
9072 LIVERNOIS AVE. • • • DETROIT 4, MICHIGAN

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ings held in New York, Cleveland, and Hollywood, Calif., during the month of November by Oakite Products, Inc.

As in former years, the meetings were in the nature of round-table discussions and included special reports presented by Oakite research chemists, service engineers and technicians on latest trends and new materials to be made available by the Company during the coming year.

The Buckeye Products Company, Cincinnati, Ohio, manufacturers of Speedie buffing and polishing compositions and distributors of a complete line of polishing room accessories, announces

E. G. Goss

the appointment of **E. G. Goss,** Elba Road, Grosse Ile, Mich., as its representative in Detroit, Toledo, and surrounding territory. Mr. Goss has had extensive experience and training in metal finishing and is well acquainted in Detroit as the result of some fourteen years devoted to sales engineering in this area. A year ago he became a manufacturer's representative and is handling buffs, polishing belts, and buffing lathes in addition to Buckeye products.

Personnel Administration. A "Conference on Industrial Personnel" at Columbia University, New York City, will be held March 19–23, it has been announced by Professor William W. Waite, head of Personnel Area of the Columbia Department of Industrial Engineering and Director of the Conference.

Under the theme of "The Frontiers of Personnel Administration", certain new concepts of personnel administration will be presented in lectures and round-table discussions between authorities on personnel administration and representatives of approximately fifty leading industrial and business concerns. Many of these new concepts and ideas have been tested experimentally in certain industrial organizations but have not as yet been widely publicized or their advantages realized on a broad front. The conference is expected to develop, on the part of the foreman, an understanding of what personnel executives are attempting to do and why, and that the personnel executive will be reminded of how foremen think and feel and of the position of the foreman in the modern industrial organization.

Professor Waite will be assisted in the direction of the conference by Mr. David N. Edwards, Instructor in Industrial En-

Accepted as the STANDARD ZINC ANO[DE]

In Case You're Not Aware of Flat-Top's Good Points...

- Distinctive shape makes confusion with cadmium or tin impossible.
- Original shape is retained right down to the nub.
- Smooth surface, free from gates and flash, prevents hanging on basket.
- Absence of pits and pockets eliminates inclusions of dirt, silicon, oxides and contamination from handling.
- Highest purity anode zinc available, processed under strict controls.
- Clean, new wooden containers, sealed against contamination. Easy to roll, truck and stack.

INDICATE A 11.

It's just two years since we introduced FLAT-TOP [to] you. And that makes it a good time to thank you pro[ducers] plating men who have made FLAT-TOP what it [is] today. From Maine to California, zinc plating shops have made FLAT-TOP welcome . . . with enthusiasm. The reasons are simple: FLAT-TOP'S basic high purity, free[dom] from contaminating dirt, grit and injurious oxides a[ssures] ease and economy of handling. It's been winning [friends] so consistently that the use of ordinary zinc [anodes] is rapidly becoming an obsolete practice.

We believe in encouraging this ready [ac]ceptance of a good product. Now we're offering [the] new zinc FLAT-TOP of even *higher* purity . . . *no* co[st] addition! We've sat up nights to *improve* our melting [equip]ment and methods and we have established *new* co[ntrol]led processing conditions which make FLAT-TOP [truly] *The Standard* zinc anode, by every criterion [of] purity.

We're shipping zinc FLAT-TOPs from coast to coast, from 25-pound kegs to carloads. Our representative in your area is ready to consult with you on your anode requirements at any time. Call him or send coupon for folders on zinc FLAT-TOP and the other Wagner anode products, copper, cadmium and nickel.

Wagner BROTHERS INC.

GOOD NEWS on NEW ANODES!

We will accept for manufacturing into Wagner Flat-Tops special high grade zinc slabs 99.99% purity. Costs are nominal, deliveries prompt. Wire or phone if you have or can obtain this metal; we'll carry the ball from there.

25% FASTER TUMBLING

New equipment and materials are combined to increase direct-labor savings over previous tumbling methods

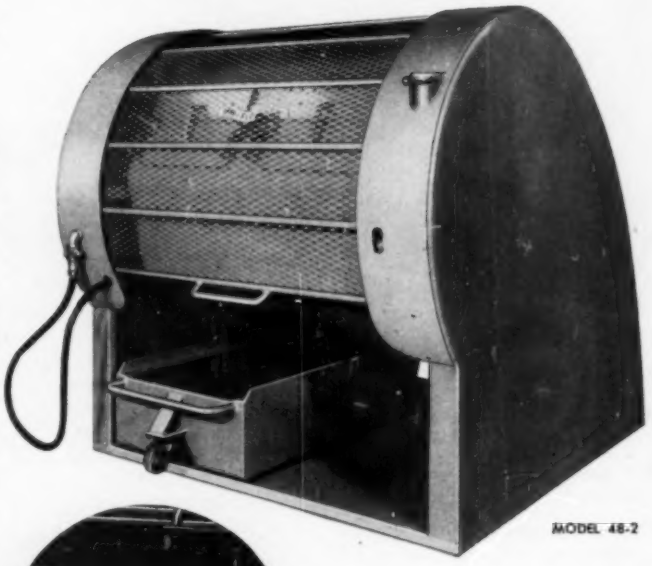
NEW MACHINE HANDLES

30% More Volume!

30% Larger Work Load!

than comparable machines occupying the same square feet of floor space.

GRAV-I-FLO offers the first big advancement in modern tumbling—with improved equipment and materials for every tumbling need. New Grav-i-Flo process, with Super-Brite finishing chips and specially designed machinery giving a smoother surface and higher lustre, now cuts 25% to 40% faster on non-ferrous metals—eliminates subsequent operations such as ball burnishing. Grav-i-Flo compounds change chip surface from finishing to cutting in minutes—parts need not be transferred from cylinder. Grav-i-Flo de-burring chips are obtainable for all de-burring needs on both ferrous and non-ferrous metals.



MODEL 48-2

Cam locks on doors have manually released safety stops for pressure relief.

New Grav-i-Flo machines are available in three sizes: cylinder size 36" x 40" dia.; 48" x 40" dia.; and 66" x 40" dia. Compartments furnished ½" plate unlined or ¼" plate rubber lined. Cam lock doors have manual release safety stops. Reduced voltage control on magnetic starter. Lever or push-button switch. Limit switch on safety guard. 220-440 volt, 3 phase, 60 cycle motor with magnetic brake. Water attachment with hose. Counterbalanced safety guard. Hoist pan has tubular yoke with manually operated lock. All standard equipment. Variable speed drive and timer controls optional.

Motor Driven Separator—welded frame supports hoist pan. Separating screen, adjustable from 0° to 1½", accommodates various sizes and types of parts. Screen inclined 5° maximum. Pan shelf provided for stock pan. One HP 220-440 volt, 3 phase, 60 cycle motor with speed reducer, and manual starter with overload protection.

Samples Processed Free! Grav-i-Flo sample processing department will gladly tell you how to attain a better finish at lower costs. Send samples to distributors or direct to Grav-i-Flo Corporation.

Distributors:

Crown Rheostat and Supply Co.
3465 N. Kimball St., Chicago 18, Ill.
W. M. Fotheringham
977 Niagara St., Buffalo 13, New York.
Sammons Brothers Mfg. Co.
3439 No. Broadway, St. Louis 7, Mo.
A. J. Lynch and Co.
2424 Enterprise St., Los Angeles 21, Calif.
E. W. Renton and Co.
877 Addison Road, Cleveland 3, Ohio.
Enthone, Inc.
442 Elm Street, New Haven, Conn.
Fotheringham Platers Supplies, Ltd.
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THE GRAV-I-FLO CORPORATION
Dept. P-1, 400 Norwood Ave. • Sturgis, Michigan

GRAV-I-FLO TUMBLING

Industry News

gineering at Columbia. Information on the conference and registration procedure is available by writing Mr. Edwards.

Pennsalt Transfers Production to Cornwells Heights Plant. The Pennsylvania Salt Manufacturing Company has transferred all production at its Easton plant to its plant at Cornwells Heights, Pa., spending approximately $250,000 to move equipment, install new equipment and improve facilities at the latter plant. Transferred to the new location are production facilities for emulsion-type metal-cleaning compounds and the eastern reshipping point for hydrofluoric acids.

R. W. Tomlinson, superintendent of the Easton plant, has been appointed superintendent of the Cornwells Heights plant, replacing R. O. White, who will be superintendent of Pennsalt's new plant now under construction at Montgomery, Ala.

Richardson-Allen Corporation, manufacturer of selenium rectifiers, battery chargers and industrial controls, has moved its office and factory to 116-15 Fifteenth Ave., College Point, Long Island, N. Y. The new, expanded facilities were needed to keep pace with the vigorous growth of the corporation and will permit continued engineering improvements on all its items.

Johnson Plastic Corporation, manufacturer of Johnsonite Plastic Pipe and extruded plastic industrial products, purchased larger plant facilities September 1. Situated on Brown Road in Chagrin Falls, Ohio, the plant covers 25,000 square feet and is located on three acres of land. At the same time, the company has acquired equipment which will more than double its production capacity. The previous Johnson plant, also located in Chagrin Falls, will continue operations.

Johnsonite flexible plastic pipe is being used extensively in the chemical industry, for municipal water systems, electrical uses of all kinds, the plating industry, and many other diversified applications.

CHEMIST WANTED

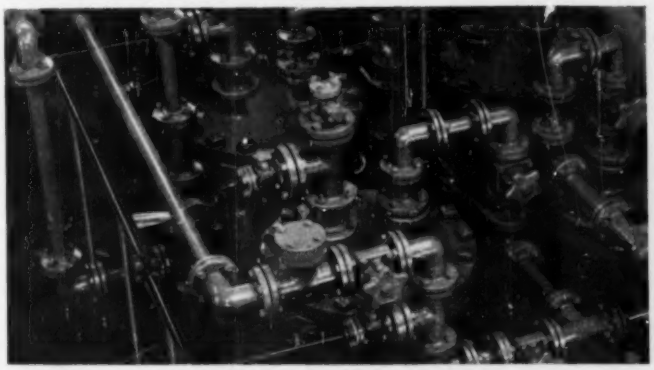
FOR SALES AND SERVICE by Midwest Equipment Manufacturer. Attractive opportunity for Chemist or Chemical Engineer between 30 and 40 with electroplating experience background. Handle both equipment and supplies, some traveling, should have car. Write giving details, past and present employment and salary expected.

Reply to:

P-151-A, PLATING
P. O. Box 168, Jenkintown, Pa.

Specify SARAN LINED steel pipe

CORROSION PREVENTION IS MORE PROFITABLE THAN EQUIPMENT REPLACEMENT!



WHAT part of industry's six billion dollar corrosion bill are you paying? Any amount is too much and can be cut considerably through the installation of saran lined steel pipe. You will find, as have many of the country's leading manufacturers, that saran lined steel pipe means dependable, long term operation. In addition to the excellent corrosion resistance of this remarkable pipe—you have the plus values of rigidity, pressure strength and ease of installation, requiring NO special tools. These advantages are all important to you in the reduction of shut-down time, lost production and equipment replacement.

Send in the convenient coupon to The Saran Lined Pipe Company, Dept. MTSP-503, for more detailed information on saran lined pipe.

★send today!

Please send me a copy of your catalog on Saran Lined Pipe, Valves and Fittings.

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SARAN LINED PIPE
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product

Wyandotte W.L.G. for heavy duty immersion cleaning

For heavy duty immersion cleaning you need Wyandotte W.L.G.* It conditions the water, removes fabricating compounds, rinses freely.

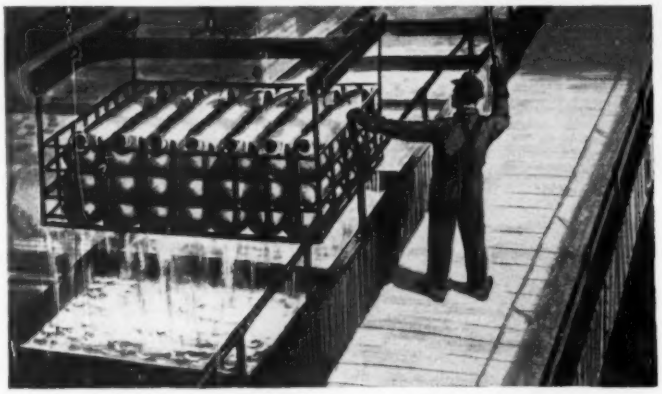
Try W.L.G. for still tank cleaning of any ferrous metal and some non-ferrous metals. (Such as copper and most copper alloys but NOT aluminum or its alloys.) Try W.L.G., too, for tumble barrel cleaning and in rotary type washing machines. It will do an excellent job for you prior to vitreous enameling, barrel plating of zinc or cadmium, dip type phosphate treatment before painting, or overhaul cleaning of engine parts, etc. Experienced Wyandotte Representatives are available. When you need technical assistance in your shop, call the nearest Wyandotte man. *Reg. U. S. Pat. Off.

WYANDOTTE

W.L.G.

Heavy duty immersion cleaner

- *Dissolves completely*
- *Conditions hard water*
- *Removes mineral and saponifiable fabricating compounds*
- *Cleans ferrous and non-ferrous metals*
- *Rinses freely*
- *Has long life in solution*



"Cleaning the World"

THE WYANDOTTE LINE—products for burnishing and burring, vat, electro, steam gun, washing machine, and emulsion cleaning, paint stripping, acid pickling, related surface treatments and spray booth compounds. ***An all-purpose floor absorbent:*** Zorball—**in fact, specialized products for every cleaning need.**

Wyandotte Chemicals Corporation
WYANDOTTE, MICHIGAN
Service Representatives in 88 Cities

Wyandotte REG. U. S. PAT. OFF.

Personals

David F. Seymour, formerly in technical sales service for the Metal Industries Department of The Diversey Corporation, Chicago, cleaner manufacturers, has been transferred to Diversey's South Gate, Calif., plant as plant manager and supervisor of manufacturing operations. He

Seymour **Foote**

succeeds **Eric C. Foote, Jr.,** who moves to the new plant of The Diversey Corporation (Canada) Ltd., Port Credit, Ontario, as plant manager and supervisor of manufacturing.

Both joined Diversey in 1947. Seymour received his degree in chemistry from the University of Minnesota and then worked with a number of large anodizing and plating companies. For two years before coming to Diversey he was with the Promat Division of Poor & Company in plating research and service. Foote received his degree in chemical engineering from Northwestern University. He was an engineer in the Technical Development Department prior to his appointment to South Gate early this year.

Carl Bauer has been promoted to the newly created post of Vice-President in Charge of Industrial Sales of Standard Varnish Works, New York and Chicago. He was formerly Industrial Sales Manager of the firm's New York operations. His new duties represent a consolidation of the Eastern and Western sales activities under a single administrative head. **J. Peter Jordan,** Industrial Sales Manager at Chicago, will continue to serve in that capacity.

George Gabriel, who has been Plant Engineer at the Mertztown plant of The Atlas Mineral Products Company, has been promoted to Assistant Plant Manager. He received his B.S. degree in Chemical Engineering from Pennsylvania State College.

E. H. McCoy, formerly with Pioneer Plating & Rustproofing Company, Minneapolis, Minn., is now with Chrome-Rite Company, Chicago, Ill.

Karl F. Jund has joined the technical staff of The Globe Chemical Company,

Cincinnati, Ohio, and will be in charge of the administration and technical service associated with the Battelle electropolishing and chemical-polishing processes which Globe sublicenses in Ohio, Indiana, Kentucky, Tennessee, West Virginia, and Chicago, Ill. Mr. Jund was formerly chief chemist of the McCauley Corporation, Dayton, Ohio, in charge of electrochemical finishing.

Fred M. King is now Market Development Manager of Food, Beverage, and Special Detergents for J. B. Ford Division of Wyandotte Chemicals Corporation, replacing **Harry A. Rightmire,** who retired.

King **Rightmire**

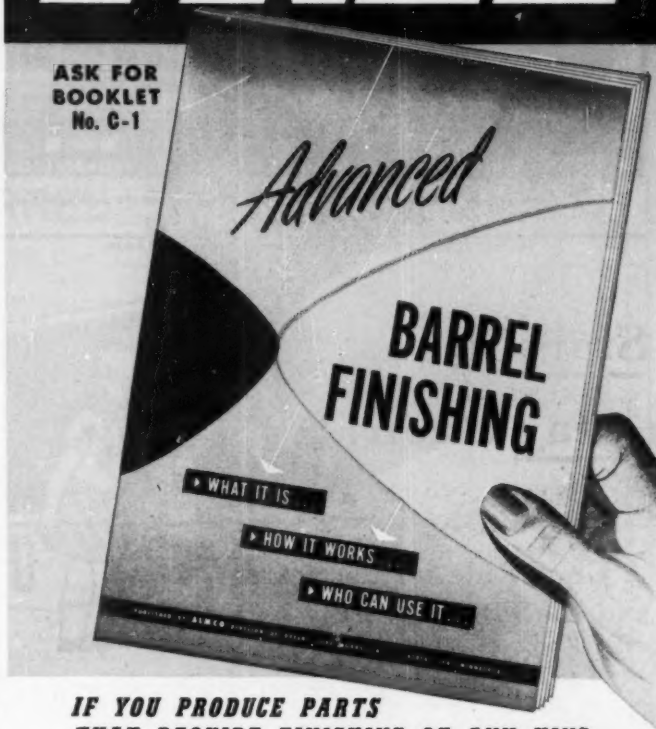
King joined Wyandotte Chemicals in 1936. After supervisory and executive assignments in Montana and on the Pacific Coast, he became Seattle District Manager in 1949. Rightmire began his career with Wyandotte in May, 1924, as a sales representative in Detroit. He was transferred to the Wyandotte Home Office in 1926 and has for several years held the position now taken over by Mr. King. Although he celebrated his 69th birthday last October, he will temporarily continue with Wyandotte in a consulting capacity and on special assignments.

B. W. Powers, formerly a Field Service Representative in Indianapolis for the Maintenance Products Department of The Diversey Corporation, Chicago, has been named District Manager for the Chicago area, with supervision over all Maintenance Products Department sales representatives working out of the Central Division. Powers joined Diversey a little over a year ago, after having served as Sales Promotional Manager for an Indianapolis firm engaged in producing and selling a construction commodity. Following four years in the Marine Corps,

Powers

FREE

ASK FOR BOOKLET No. C-1



IF YOU PRODUCE PARTS THAT REQUIRE FINISHING OF ANY KIND

This 22-page booklet is guaranteed to open your eyes! It gives you the inside story of advanced barrel finishing as never told before!

In the last five years, barrel finishing has made rapid advances. Only those directly connected have been able to keep up. Only 30% of the nation's manufacturers are benefiting from the tremendous cost savings and improved finishes made possible by these advances.

Now is the time to investigate this labor-saving, cost-cutting method. ALMCO barrel finishing equipment has completely paid for itself in as little as two months! This is easy to understand. A single unit installation replaces from two to twelve men. Savings run as high as 95%.

"Advance Barrel Finishing" is the only mass deburring, grinding and finishing method where results are controlled. Amazing results are now possible on almost all types of parts from large castings to small intricate parts. Close tolerance parts can be finished with absolute uniformity to almost any desired micro-inch reading.

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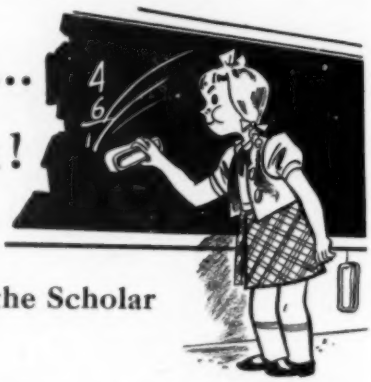
AMERICA'S LARGEST MANUFACTURER OF ADVANCED BARREL FINISHING EQUIPMENT—MATERIALS AND COMPOUNDS

ALBERT LEA, MINNESOTA

A few choice territories still open for JOBBERS or DISTRIBUTORS on the Schaffner line. Phone or wire us today collect.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 16.

Start Clean... Stay Clean!



A Good Rule for the Scholar and the Plater

A lot of expensive time and labor goes into preparing metal for plating. *You can waste it all by putting the work into a plating bath of questionable purity!*

Start clean . . . *stay* clean! Red Label Darco S-51 adsorbs to *its* surface the impurities that cause trouble in plating baths before they can be deposited on the freshly cleaned surface of your work.

Red Label Darco is especially treated for use in plating—*the only carbon that meets the benzol-mercury test!* It is especially easy to handle . . . to wet . . . to incorporate into a slurry. Place an order for Red Label Darco S-51 today. Practically all leading suppliers carry Darco in stock. *Do not accept substitutes!*

Is your plating bath as clean as the water in your final rinse?

DARCO DEPARTMENT
ATLAS POWDER COMPANY
Darco General Sales Offices
60 East 42nd Street, New York 17, N. Y.

he studied business administration at Franklin College, Franklin, Ind.

Michael M. Sadlowski is now Plant Manager; **John Schmidt,** Production Superintendent; and **Edward J. Petrenik,** Chief Chemist of the Lacquer Division of Standard Varnish Works, Linden,

Sadlowski **Schmidt**

Petrenik

N. J. Both Sadlowski and Schmidt have served in Standard's Lacquer Division for many years. Petrenik, a newcomer to the firm, has been active in the research and development of paints and lacquers for several prominent manufacturers in the industry.

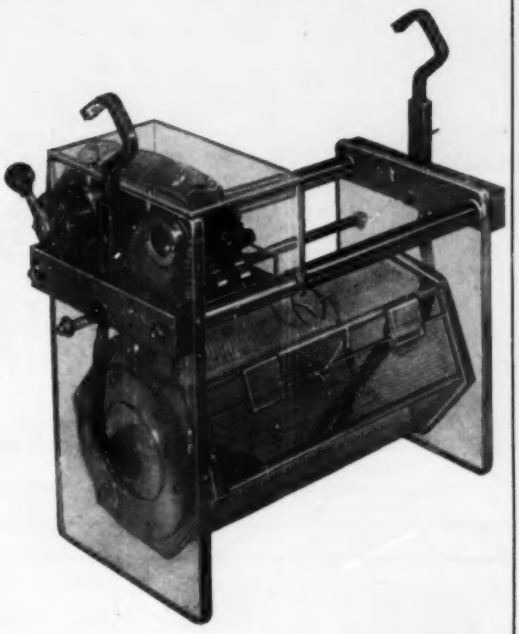
John Hellstrom, Vice-President of the American Air Filter Company, Inc., Louisville, Ky., is now Manager of the newly created Pacific Division, with headquarters in the Standard Oil Building, 225 Bush Street, San Francisco, Calif. Under his direct supervision will be the business activities of both American Air Filter Company and its Herman Nelson Division of Moline, Ill., in the Pacific territory: California, Oregon, Washington, Idaho, Montana, Utah, Arizona, New Mexico and Western Texas. A pioneer of air filtration and dust control, he was President of the Midwest Air Filters, Inc., until it was merged with other companies to form the American Air Filter Company, of which he became Vice-President in charge of the Dust and Fume Control Division.

Walter F. Swanton, formerly Instructor in Metal Finishing with Rochester Institute of Technology, is now Chemical Process Engineer with The Pfaudler Company, Rochester, N. Y. He will specialize in Pfaudler's chromic acid-recovery system.

Charles B. McCoy, Director of Sales of duPont's Explosives Department, has

BEST —in APPEARANCE —MECHANICALLY —in PRODUCTION

The Original "Lucite Ribless" PORTABLE PLATING BARREL



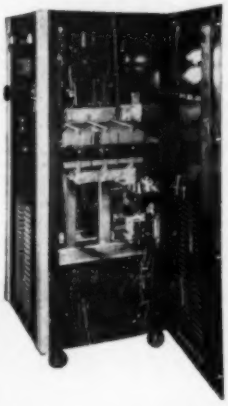
Revolves through the entire plating cycle without transfer of load from one cylinder to another. Maximum solution temperature 185 F.° Made in Two Sizes:

6" x 12".....*$203.50*
8" x 18".....*$302.50*

with reversing switch and plug-in cord and with standard perforations of 3/32" or larger.

Small perforations
$8.25 to $27.50 extra.

As Lucite is non-absorbent, one unit can be used for all your solutions. Order today—this is the best investment you can make for your plating room.



Stutz Selenium Rectifiers... *The Finest of All*

Ideal for still, barrel, and automatic tank operation!

We invite your inquiries covering any amperage or voltage.

Don't Delay—Order Today!

STUTZ — *Your Guarantee of Quality!*

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GEORGE A. STUTZ MFG. CO.

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Does Your Maintenance Show?

LEAD LININGS by Storts serve long and serve well —show lasting utility under severe acid conditions. Insist on STORTS quality in your lead-lined tanks— your investment will pay off in more years of trouble-free operation.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

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BETTER THAN EVER

The True Insulator will give you more safety than before with the same standard of insulation as always. Wire braid hose on the ¾" and 1" sizes insures absolute freedom from failure. The ½" size has been completely redesigned to give higher quality with longer life. With all these improvements the True Insulator is a better bargain than ever.

THE TRUE INSULATOR

is specifically manufactured to insulate your plating operations from grounds and short circuits through the heating coils, cooling coils, air agitation systems or other pipe connections. The True Insulator provides more positive insulation than any other type known.

Available in following sizes

½ inch.....$7.00 per pair
¾ inch.....$7.50 per pair
1 inch.....$8.50 per pair

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PRACTICAL PRODUCTS FOR PRACTICAL PEOPLE

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Personals

been appointed Assistant General Manager of the company's Electrochemicals Department. He succeeds **Donald O. Notman** who became general manager of the Electrochemicals Department.

McCoy, 41 years old, has been with duPont since 1928 when during summer vacations he started work as a laboratory helper. He attended the University of Virginia, where he received his B.Sc. degree in chemistry in 1930, and Massachusetts Institute of Technology, which gave him a M.Sc. degree in chemical engineering in 1932. He has held many positions with the company, among them with the Foreign Relations Department's London office, 1935–1939.

R. A. Hoffman is now Director of Research of Allied Research Products, Inc., Baltimore, Md. He joined Allied Research on February 1, 1950, having previously been associated with E. I. duPont de Nemours & Company as a Research Chemist and The R. A. Hoffman Chemical Company, Cleveland, as President. Mr. Hoffman is a graduate of Ohio State University and later received a degree of Master of Chemistry from Western Reserve University.

Hoffman

W. M. (Mel) Teets has been transferred from the laboratory staff to the sales force by the Hanson-Van Winkle-Munning Company, Matawan, N. J., and will have his headquarters in the company offices in New York.

Teets

In 1943 he joined the Army Air Force and flew twenty-eight missions over Germany. In February, 1946 he entered Lafayette College in Easton, Pa., from

you can get low-cost, bright zinc plating

with DU PONT "DUROBRITE" ADDITION AGENT 309

RUGGED • ECONOMICAL • HIGHLY EFFICIENT

in barrel, still, semi- and full automatic units, "Durobrite" Addition Agent 309 offers these outstanding advantages:

- ★ **Can be used for any type of cyanide zinc plating—in all types of plating equipment.**
- ★ **Allows increased output with materials at hand.**
- ★ **Increases throwing power of the bright plating range—provides greater lustre.**
- ★ **Assists in consistent production of uniform bright plate.**
- ★ **Gives deposits suitable for subsequent passivating treatments.**

Tune in to Du Pont "CAVALCADE OF AMERICA" *Tuesday Nights—NBC coast to coast*

DU PONT *Chemicals • Processes • Service*
for **ELECTROPLATING**

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

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on "Durobrite" Addition Agent 309, ask your Du Pont Technical Representative . . . call our nearest office . . . or mail the coupon below.

DISTRICT SALES OFFICES: Baltimore, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, El Monte (Calif.), New York, Philadelphia, Pittsburgh, San Francisco.

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Electrochemicals Department,
Wilmington 98, Delaware

Please send me more information about "Durobrite" Addition Agent 309 for use in plating . . . . . products.

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News about UNICHROME Trade Mark COATINGS for METALS

METALLIC ORGANIC DECORATIVE PROTECTIVE

Why use two prime coats on racks?

Unichrome primer 219PX is a *single* prime coat system for plastisol rack coatings that *works*. Used with the highly chemical-resistant Unichrome Coating 218X, it assures lower application costs and rack protection that adheres through every plating cycle, including vapor degreasers!

For a zinc finish that stays bright

Because it gives zinc plate a brilliant lustre, protects it from corrosion, and costs so little, Unichrome Dip Finish is being used extensively on refrigerator shelves today.

Less buffing for copper plate

Without using brighteners, Unichrome Pyrophosphate Copper deposits a s-m-o-o-t-h plate. If needed at all, buffing of this ductile copper takes less time and effort.

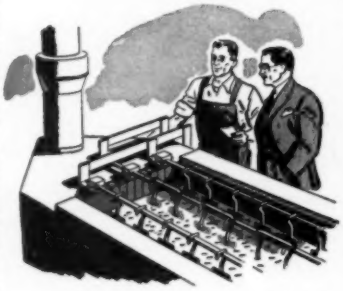
Beating corrosion in plating plants

Tanks, ducts, metal work, walls, concrete floors—when protected with Ucilon Coating Systems—withstand acids, alkalies, water, cleaners, as well as fumes and splashing from all plating baths.

CHROMIUM NOW PLATED 20% to 80% FASTER!

Here are actual results obtained by users of the New Unichrome S.R.H.S.* CHROMIUM SOLUTION

**(self regulating high speed)*



1. AUTOMOTIVE SUPPLIER was able to meet chromium thickness specifications and still cut plating time to 100 seconds, because the S.R.H.S. bath plated 40% faster. Formerly they had to load generator, but S.R.H.S. Chromium enabled them to use lower amperage. Result: Fewer rejects, lower operating costs.

2. WELL KNOWN ELECTRICAL COMPANY found that S.R.H.S. Chromium deposited .0029" an hour. This was 55% faster than in the ordinary solution. The deposits had better color, and less treeing and nodules.

3. LARGE CONTRACT PLATING PLANT plates rings in 35 minutes. Formerly took 65 minutes in ordinary chromium bath. And whereas the ordinary solution gave .002" build-up on edges, this problem is practically non-existent with the S.R.H.S. bath.

S.R.H.S. Chromium Baths are especially valuable today in stepping-up output of vital hard chromium plate. But as you can see, speed isn't all. S.H.R.S. Chromium also provides more uniform quality, and a consequent reduction in rejects. Its "leveling-action" reduces surface finishing. It has higher cathode efficiencies, and plates brighter over a wider current range, with less likelihood of burning and "missing." A self regulating solution, it seldom varies from optimum plating balance.

Developed by "Coatings for Metals" headquarters, Unichrome S.R.H.S. baths can help you do more profitable plating. Write for bulletin.

UNICHROME Trade Mark

UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y.
Detroit 20, Mich. • Waterbury 90, Conn. • Chicago 4, Ill.
Los Angeles 13, Cal.
In Canada: United Chromium Limited, Toronto, Ont.

Personals

which he graduated in 1949 with a B.S. degree in Electrical Engineering. He then joined Hanson-Van Winkle-Munning Co.

Henry L. Grimme now represents Wyandotte Chemicals' Industrial Department in Kansas City. Mr. Grimme previously sold chemicals in the Kansas-Missouri area and was technical advisor

Grimme

in that section for a division of Armour & Company. His four years in college and university chemistry were secured before and after three years in the U. S. Marine Corps, which he entered a private and left as a first lieutenant.

Chauncey U. Estabrook, formerly with The Udylite Corporation, has joined the Wm. C. Peters Company, industrial builders in the Greater Detroit area, as engineer in charge of acid-proof engineering and construction of tanks, pits, floors, and buildings for plating, pickling, and neutralizing installations. His work will have to meet stringent City of Detroit waste-disposal requirements.

Obituaries

✠G. J. SCHAFFNER died of a heart attack on December 1 at the age of 65. Besides his widow, Mrs. Kathryn McAleer Schaffner, he is survived by three sons, Gus J., Jr., Paul E., and Robert D.; one daughter, Mrs. Betty McAndrews, and six grandchildren.

Schaffner was born in Bellevue, Pa., and lived there all his life. He was one of the founders and at his death Vice-President of Schaffner Manufacturing Company, manufacturers of buffs and buffing compounds; a charter member and past president of Bellevue Volunteer Fire Department; a charter member of Bellevue Council 1400, Knights of Columbus; and one of the first parishioners of Assumption R. C. Church of Bellevue, where a Requiem High Mass was sung on December 4 prior to his burial in Calvary Cemetery.

✠**Clarence G. Spence,** owner of the Spence Electro Plating Company, Los Angeles, passed away on October 26, at Tule Lake, Calif., as a result of a heart attack suffered while on a duck hunting trip.

Born August 7, 1884 at Brighton, Ill., he started work for the St. Louis Car Company, St. Louis, Mo., as a striper and decorator. At the age of 21 he was sent to Brazil and spent two years supervising the lettering and decorating work for the first street railway system in Rio de Janeiro. He returned to this country via Europe. After his return he located first in Seattle, Wash., and later in Los Angeles, where he operated several restaurants and spent several years as a decorator and scenic painter in the early Fox Movie Studios.

In 1920 he entered the enameling business, founding the Western Enameling Company in Los Angeles, and later added a line of electroplating. In 1926 he built the present plant at 528 E. 15th Street, and in 1947 he tripled the size of his plant and operated it as the Spence Electro Plating Company.

Spence was a leader in the industry in the Los Angeles area. He was one of the first three to adopt chromium plating and pioneered in the plating of zinc diecastings, a line in which his plant has since specialized. At the time of his death his company was doing a general line of electroplating, as well as anodizing and Alumi'iting of aluminum.

Spence was active in the affairs of his industry as a member of the American Electroplaters' Society and the National Association of Metal Finishers, and he served as the local president of the latter organization in 1946 and 1947. He also found time for many outside interests. He was an ardent hunter and fisherman and held a private pilot's license for flying his own plane.

Services were held in Grace Chapel, Inglewood Cemetery, on October 31, 1950, with burial in the family plot.

Spence is survived by his wife, Mrs. Clara G. Spence, and one sister, Mrs. George Rogers of Avalon, Calif.

Lustrous

Are you seeking newer and better methods . . increased production . . lower costs . . less accidents? Investigate the *SIEFEN SYSTEM* of lustrous polishing and buffing without delay!

WRITE FOR FURTHER INFORMATION

J. J. Siefen CO.

5641 LAUDERDALE · DETROIT 9, MICH.
Nationwide buffing and polishing service

Trade Literature

L—536. Zinc-compounded Finishes—Industrial Metal Protectives, Inc., 401 Homestead Avenue, Dayton 8, Ohio, offers an 8-page illustrated bulletin, "Zincilate", which describes its Zincilate No. 100 (a surface-penetrating finish requiring baking) and Zincilate No. 300 (a non-penetrating finish which air-dries quickly). Both contain zinc for sacrificial protection of ferrous metals. Additional finishes may be applied over them. Details of application and properties are given. For your copy, use Reader Service Card.

L—537. Trolley Busway System—Feedrail Corporation, 125 Barclay Street, New York 7, N. Y., has issued a 64-page Catalog No. 25 illustrating and describing its prefabricated trolley busway electrical-distribution system. The catalog is planned in sections to make easy the selection of equipment by those who plan and specify electrical installations in operations involving sewing, portable tools, materials handling, cranes, hoists, etc. There are special sections on planning, layouts, installation, and specification. For your copy, use Reader Service Card.

L—538. Stream Pollution—A pattern for intergovernmental and civic cooperative action on the growing problem of pollution of the Nation's water resources is set forth in a Public Health Service Publication No. 11 entitled "Clean Water Is Everybody's Business". It describes the effect of water pollution on all aspects of life, especially health, business, and recreation, and points out the need for cooperation among communities, industry, and State and Federal Governments in pollution prevention and abatement. It explains how in five steps a program of public action can be carried out to develop comprehensive water-pollution control programs, stimulate construction of treatment works, provide technical aid and research, encourage recovery and use of waste products, and invoke enforcement measures when necessary. Single copies are available without charge from the Public Health Service, Federal Security Agency, Washington 25, D. C.

L—539. Small Filter—Sethco, 105–107 150th Street, Jamaica 4, N. Y., announces a 6-page brochure describing its line of small Filter Pump Units with stainless-steel or high-temperature Lucite cylinder enclosing the filter tube, and stainless-steel pump and fittings. The filter tube consists of a processed cotton yarn wound around a stainless-steel supporting cone. The units can filter 50–100 gph of acid or alkaline plating solutions. The brochure is fully illustrated and includes technical data and prices. For your copy, use Reader Service Card.

L—540. Power Brush—A 4-page 2-color booklet describing its recently developed line of "Heli-master" power brushes is being offered by The Osborn Manufacturing Company, 5401 Hamilton Avenue, Cleveland, Ohio. Many photographs illustrate the design and use of the new brush, and complete instructions for ordering and specifications for use are included. Inserted is an Application Data Sheet which can be filled out by a company having a cleaning, scrubbing, or finishing problem which could be solved by brushes. For your copy, use Reader Service Card.

L—541. Plant Sanitation and Maintenance—"New Ideas on Plant Sanitation and Maintenance" is the title of a 16-page illustrated booklet now available from the G. H. Tennant Company, 2530 N. 2nd Street, Minneapolis, Minn. Reprint of an address by J. Lloyd Barron, Manager of the Sanitation Department, National Biscuit Company, New York., the booklet includes specific answers to often-asked questions on maintenance and sanitation, and has a well-indexed table of contents for easy reference. For your your copy, use Reader Service Card.

L—542. Strippers for Organic Finishes—A 4-page illustrated booklet describing various strippers for removal from metals of synthetic organic coatings, including lacquers, enamels, and varnishes, has been issued by Enthone, Inc., 442 Elm Street, New Haven, Conn., Dept. P. Strippers described include room-temperature fast-evaporating strippers, emulsion-type materials that are mixed with

ONE MAN OPERATION with BLAKESLEE METAL PARTS WASHERS

BLAKESLEE SOLVENT VAPOR DEGREASERS —economical, efficient— USE LESS SOLVENT

BLACOSOLV
Stabilized Degreasing Solvent — one price, one solvent *for all metals*

Blakeslee's new washer saves labor, is economical

Just one man can keep the production line going with this time saving metal parts washer. Turn table operation permits loading and unloading in one easy pivot movement. One revolution of the washer turn table and parts come out sparkling clean for a better finishing job with fewer rejects. Blakeslee washers are designed for every type and size of plant operation. Write for the cooperative services of our engineer-trained sales representatives.

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water and used at room temperature and heated, and brush-on type strippers. For your copy, use Readers Service Card.

L—543. Water Stills—Both industrial and laboratory stills manufactured by Precision Scientific Company, 3737 W. Cortland St., Chicago 47, Ill., of the gas or electric heated type, are now protected from being burnt out by means of an electrical water contact arrangement. This new device, described in the company's Bulletin 911, can be installed by the user on older stills. For your copy, use Reader Service Card.

L—544. Bright Copper Plating with PR or DC Current—Technical instructions have been issued by Hanson-Van Winkle-Munning Company, Matawan, N. J., for the use of the Wes-X addition agent in organic-free all-potassium cyanide plating baths for maximum leveling, buffability, speed, ductility, throwing and covering power. Detailed methods of analysis and an effective test for determining the local thickness of H-VW-M bright copper deposits are included. For your copy, use Reader Service Card.

L—545. Protection of Aluminum—Pyrene Manufacturing Company, 560 Belmont Ave., Newark 8, N. J., has issued an 8-page illustrated booklet which describes the simple and inexpensive Pylumin process for the protection of aluminum, either painted or unpainted, without the use of electric current. Instructions for operating are included. For your copy, use Reader Service Card.

L—546. The Real Secret of Better Plating—This is the title of a most interesting 10-page pamphlet, available free of charge to plating executives who request it on their letterheads and to individuals connected with the industry who in submitting their request mention their company's name and their position. For your copy, write to Joseph B. Kushner Electroplating School, 115 Broad St., Stroudsburg, Pa.

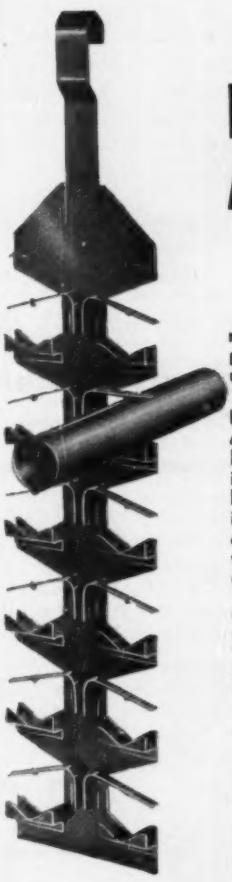
L—547. Chemical Resisting Coatings—A bulletin describing five groups of chemical-resisting Ucilon Protective Coatings has been made available by United Chromium, Incorporated, 100 E. 42nd St., New York 17, N. Y. Described are coatings based on vinyl resins, phenolic resins, fish oils, chlorinated rubber, and also water-emulsion coatings. The coatings are resistant to acids, alkalies, petroleum and its derivatives, water, oxidants, salt solutions, alcohols, and many solvents. For your copy, use Reader Service Card.

L—548. Dipping Baskets—Hanson-Van Winkle-Munning Company, Matawan, N. J., offers a Bulletin D-107 which describes proper selection of material for dipping baskets used in cleaning, plating, etching, bright dipping and deoxidizing cycles. It also contains tables covering an extremely wide range of materials, meshes and sizes of wire for standard baskets. Special baskets are also available, designed and manufactured to individual specifications and requirements. For your copy, use Reader Service Card.

L—549. Sodium Acetate—Niacet Chemicals Division, 1021 Niagara Bldg., Niagara Falls, N. Y., offers Bulletin No. 2 on Sodium Acetate, which presents in detail the physical and chemical properties, latest specifications, and shipping and handling information on this well known and widely used chemical. For your copy, use Reader Service Card.

L—550. Plastic Sheet, Rod and Tube—Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y., offers a 4-page Bulletin 601 describing Hysol 6000, a thermosetting plastic material of high chemical resistance and dielectric strength. Used as a casting resin, it is said to offer unusual adhesion to metals, glass and ceramics. Temperatures up to 230° F are withstood continuously, up to 350° F intermittently. For your copy of the bulletin which contains much data on machining, electrical and chemical-resistance properties, use Reader Service Card.

L—551. Vapor and Mist Control—Bulletin 619, issued by Aget-Detroit Company, Ann Arbor, Mich., describes how seven representative companies approached the problem of stopping the spread of vapor and mist from various machining and other vapor-generating operations. Among the concerns are a leading manufacturer of gear hobs; a producer of valves; a user of thread grinders; a concern that cleans oil parts with an air blast. For your copy, use Reader Service Card.



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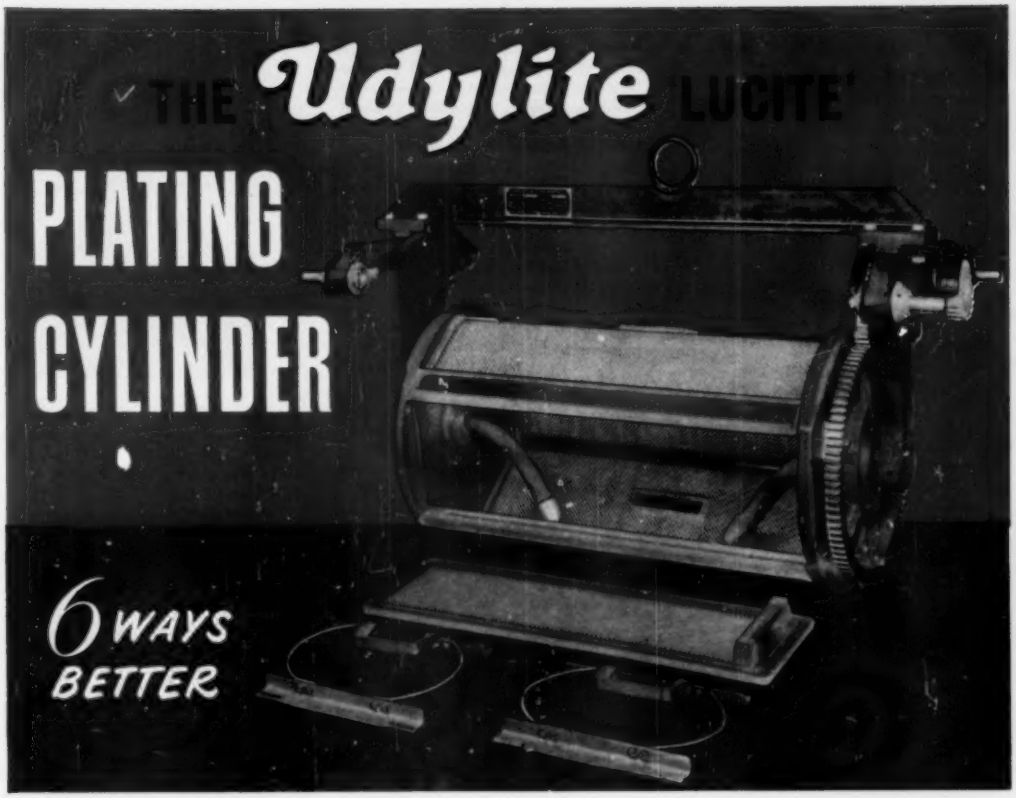

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6. OPERATES THROUGH ENTIRE CYCLE (ACID OR ALKALINE)

Consider the advantages of the Udylite 'Lucite' Plating Cylinder. This cylinder is made of heat resistant 'Lucite'—which offers greater abrasion resistance. And the shell is *mortised* and *cemented* into the cylinder heads—with door openings machined to a very close tolerance, providing perfect fit. Door clamps are designed to give maximum support to the door panel yet open easily and freely. Oversized superstructure with "Deep-Dip" design allows the cylinder to hang deep in the solution.

This 'Lucite' cylinder can be operated through the complete cycle—either acid or alkaline. And most important—the Udylite 'Lucite' Plating Cylinder is offered in 4 sizes with perforations 1/16" Diameter and Larger.

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PIONEER OF A BETTER WAY IN PLATING

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

Equipment and Supplies

E—602. Air-Cooled Buff—A patented, pressure-cooled buffing wheel, the "Airflow" buff, has been developed and is being manufactured for the metal and plastic industries by the United Buff Products Corporation, 233-241 Oak Street, Passaic, N. J. The buff, of unit-type, metal-center design, does not require any additional inserts, fillers, spacers, etc.

The buffing wheels are made of various cloths for many applications. The buff will not ravel, can be run at higher speeds without burning than heretofore possible, and will retain liquid or bar compounds effectively, it is claimed.

Originally developed for the automotive industry, the "Airflow" buff is being widely used by the lamp, silver, aluminumware, cutlery, plumbing supply, hard rubber, and plastic fields. When used on plastics it is said to eliminate burning, distortion, flowing and warpage. It is now being sold as far West as Arkansas, but sales distribution will soon be set up to the West Coast. For further information, use Reader Service Card.

E—603. Barrel Pump—General Scientific Equipment Company, 2700 W. Huntingdon St., Philadelphia 32, Pa., offers a low-priced pull-type pump for light liquids. It drops into drum opening and holds pump securely to drum by means of thumb screw. It fits 1½- and 2-inch openings on 15-55-gallon drums. Material is steel except spout. For further information, use Reader Service Card.

E—604. Flexible Light-Weight Conveyor—The accompanying illustration shows a conveyor system developed by Lightweight Conveyor Co., 18690 Lauder Ave., Detroit 35, Mich., to meet the needs of both large and small manufacturers for conveying relatively light parts. The Lightweight Champion Monorail-Type Conveyor can be operated as a bench, overhead, or even portable conveyor system. The system shown is a continuous belt, 256 feet long, requiring only a 1/3-hp motor, weighing approximately 3 pounds per foot, and requiring no super structure.

It is a "package" conveyor sold in 2-, 4-, 6-, 8- and 10-foot sections with "els", 45's, etc., similar to standard pipe. It is as simple to set up as an "Erector" set and, like it, can be rearranged as plant needs change. For further information use Reader Service Card.

E—605. Washable Marking Crayon—Washable marking crayons that can be used on metal, glass and wood are now available from the Celco Corporation, 1631 Tenth St., Santa Monica, Calif.

Crayoffs, as they are named, are made with a patented soap base in eight colors —green, yellow, brown, terra cotta, black, blue, red and purple. For further information, use Reader Service Card.

E—606 Colored Rust-inhibiting Enamel—A double color system is what The Wilbur & Williams Company, Boston 15, Mass., has been able to produce in its 1951 line of Totrust Enamel. Not only do they match almost thirty equipment manufacturers' original colors, but the colors are also applicable for identification of pipes and for the machinery safety code. A color chip card, using actual paint instead of ink and therefore showing the paint gloss, is available. For your copy, use Reader Service Card.

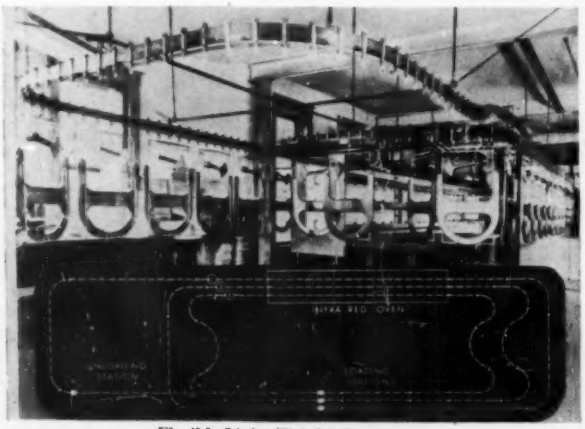
E—607. Plastic Jug for Hydrofluoric Acid—The first use of plastics in packaging hydrofluoric acid for industrial use has been announced by Baker & Adamson Products, General Chemical Division, Allied Chemical & Dye Corporation of New York City.

The new development is a molded polyethylene jug used to ship 10 pounds of B&A Technical Grade Hydrofluoric Acid and other liquid chemicals in small industrial lots. The package weighs only two pounds and is said to be shatterproof, tough, translucent and acid-resistant and not develop dangerous leaks common to the lead containers. In addition to ease of handling there is a freight saving of 15 pounds tare weight for each 10 pounds of acid purchased. For further information, use Reader Service Card.

E—608. Plastic Tubing—With the completion of its new program of plant and equipment expansion, Munray Products, Inc., Division of the Poly-Cyclo Products Company, 12500 Crossburn Ave., Cleveland 11, Ohio, makes available its Cyclon crystal-clear, flexible plastic tubing.

Extruded to a variety of diameters (from 1/64 to 1½ inch I. D.) and wall thicknesses, Cyclon Tubing can be utilized for pressure and vacuum operations, usually without encumbering clamps, wires, etc., for union to glass and metal connectors. It is said to be superior to rubber in its resistance to chemical attack by inorganic acids, alkalies, oils, greases, soaps, and the general aliphatic hydrocarbons. Being thermoplastic, Cyclon is not recommended for continuous exposure to corrosives at temperatures above about 180° F. Black Cyclon tubing, cord and channel are claimed to have performed outstandingly in all electroplating solutions as rack insulation and for the stopping-off of parts to be selectively plated.

E—609. Sprayed Coating Simulates Brass and Gold Finishes—A ready-mixed metallic enamel with good package stability is offered by Rexton Finishes, Inc., 62 Woolsey St., Irvington 11, N. J. Said to be easily sprayed to produce an



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For over three years, NO-CRO-MIST has been helping Chrome Plating in these important ways:

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Solves the problem of maintenance of ventilating equipment; keeps chromic acid in the tank where it belongs instead of letting it destroy ventilating equipment, roofs, grass or automobile finishes. Re-racking between nickel and chrome can be avoided; busbars are kept cleaner.

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Can be used economically in any strength bath containing 25 to 54 oz./gal. chromic acid by improved system for addition. Saves chromic acid.

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Improves covering power and extends the plating range of the bath. Solves many problems of plating around holes and recesses.

SAFEGUARDS HEALTH

NO-CRO-MIST is a soluble addition agent that eliminates up to 95% of chrome spray evolved in plating. This means that fumes are eliminated from the plating room (especially noticeable in summer) and health of workmen is safeguarded.

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Operating Temperature ..... °F.
Chromic Acid Content .....

NAME .....
COMPANY .....
STREET ADDRESS .....
CITY ..... ZONE ..... STATE .....

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 28.

effect similar to a fine brass, bronze or gold-powder finish and designated AUREX, this material has found particular acceptance in the finishing of TV masks and decorated parts of radio receivers. The manufacturer claims a uniform, plated effect and availability in air-dry or baking formulation. For further information, use Reader Service Card.

E—610. Reconditioning Service for Work Gloves—A new work-glove reconditioning service that by actual study is saving one large user over 80 per cent of all gloves sent in for salvage is now

offered on a national basis by U. S. Industrial Glove Corporation, 9350 Roselawn Avenue, Detroit 4, Mich. In many instances workers are said to prefer reconditioned gloves to new gloves because of their pliability and comfort.

The service, which should not be confused with ordinary industrial laundering, includes complete renovation, sanitizing and packaging of all types of worn-out fabric and leather gloves and protective clothing. Special equipment and methods have been developed for performing the operations. For further information, use Reader Service Card.

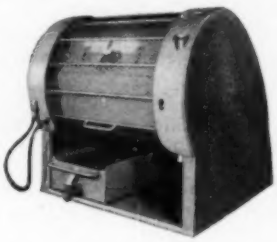
E—611. Corrosion and Wear-Resistant Coating—Carboline Company, 7603 Forsyth Blvd., St. Louis 5, Mo., has issued a Data Sheet which sets forth the advantages, limitations, corrosion resistance, uses, application and cost of a modification of phenol formaldehyde resins that requires no baking to obtain maximum hardness and corrosion resistance. Called Phenoline, it is applied by brush in coats 10 mils thick, hardening at normal temperatures into a tile-like coating, which when properly applied is said to be resistant to wear and impervious to practically all solvents and to all inorganic acids except strong oxidizing solutions. It is available in colors.

Phenoline can be used on floors and for lining of tanks. For further information, use Reader Service Card.

E—612. Aluminum Etching Compound—The Metal Industries Department of the Diversey Corporation, 1820 Roscoe St., Chicago 13, Ill., has introduced a new type of alkaline etching compound for all aluminum alloys. Called ALUMINUX, its use is said to eliminate cement-like scale and sludge from tank and coils and to guarantee a uniform, high-quality etch at lower cost. For further information, use Reader Service Card.

E—613. High Capacity Tumbling Machine—A new tumbling machine designed for grinding, deburring and finishing metal parts is now being offered by the Grav-i-Flo Corporation, 400 Norwood Ave., Sturgis, Mich. Employed in the Grav-i-Flo tumbling process using Grav-i-Flo chips and compounds to produce smooth and high-lustre surfaces, the new machine has a 5–2/3 foot width x 5–1/3 foot depth x 5–2/3 foot height. With its two 24 x 40-inch I.D. compartments, it is rated to handle a 30 per cent larger work load than comparable machines occupying the same floor space. A number of additional features are included.

Other equipment and materials available for the Grav-i-Flo tumbling process include Super-Brite finishing chips rated to cut 25 per cent faster on nonferrous metals, and which eliminate such subsequent operations as ball burnishing; compounds, which change chip surface from finishing to cutting in minutes, thus elimi-



nating need of transferring parts from cylinder; natural and synthetic deburring chips for all metal alloys; motor-driven separator for removing chips from parts. For further information use Reader Service Card.

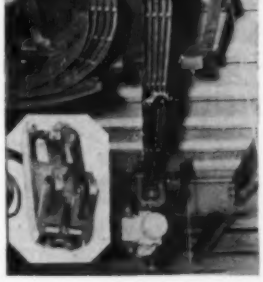
E—614. Sequestering Agent for Alkaline Cleaners—Enley Products, Inc., 254 Pearl St., New York 7, N. Y., offer Cleaner Saver which when added to any cleaner in small quantities (½ ounce to the gallon) is said to increase the useful life up to double, and produce a more active and cleaner surface for plating or other operations. According to the supplier, it dissolves metallic soaps, inactivates heavy-metal and alkali-earth ions, cleans metallic surfaces of oxide films, stabilizes metasilicate baths, withstands high temperature and high alkalinity indefinitely, is nonvolatile, and remains stable and effective over a wide range of *p*H. For further information, use Reader Service Card.

E—615. Solvent Cleaning Machines—The Phillips SolVoJet, manufactured by

Phillips Mfg. Co., 3475 Touhy Ave., Chicago 45, Ill., Dept. P., is designed for safe, rapid and thorough cleaning. Because it handles petroleum, emulsion, and light compound solutions, as well as toxic and nontoxic solvents, any new cleaning problem is solved quickly by recharging the unit with the proper solvent.

Soil is removed by room-temperature-solvent action and the pressure jet required to dislodge stubborn particles is supplied by a carefully selected rotary pump equipped with mechanical seals. The pump is operated by a foot switch, and a conveniently located adjusting valve permits quick regulation of the pressure. The operator is free to work with both hands, one directing the jet of solvent while the other manipulates unexposed surfaces. The cleaned parts are then drained or subjected to compressed air blowoff as required. For further information, use Reader Service Card.

E—616. Tramrail Shielded Electrification—A tramrail and crane shielded electrification system for three-phase operation with capacities to 600 volts at 75 amperes is available from The Forker Corporation, 2117 Random Road, Cleveland 6, Ohio. It is reported to reduce arcing and flashing of conductor bars by use of large-area shoe contacts with individual springs in each shoe. Installed directly below the tramrail track tread, OHIO Tramrail Shielded Electrification is said to offer operating and maintenance personnel more complete protection from



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electrical hazards encountered with open conductor bars. Chance for casual contact is minimized by combining the safer under-the-track location with a compact 16-gauge sheet-metal housing which shields conductor bars from the top and two sides. The conductor bars are supported in the metal shield and insulated by phenolic-resin linen-impregnated tubing on ¼-inch rivets through the steel.

The electrification systems are factory fabricated in 10-foot lengths for erection on the job. Clearance from track tread to ceiling is the same for both hand-powered and electrified systems. Any OHIO Tramrail hand system can be readily converted at low cost by adding Shielded Electrification to the bottom of the track, without any changes to the existing system. For further information, use Reader Service Card.

E—617. Copper Blasting Shot—Non-ferrous castings in brass, bronze, and aluminum can be readily cleaned with Harrison L/D Copper Cleaning Shot without sand or steel grit blasting particles becoming imbedded in the work, according to Harrison Abrasive Div., Metals Disintegrating Co., Inc., Elizabeth, N. J.

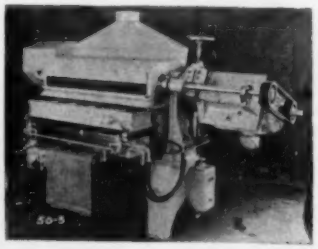
This shot can be used either in air-type or wheel-type machines. It is made from high-grade copper wire in the form of small cylinders with length equal to diameter. This uniformity assures repeated duplication of finish. For further information, use Reader Service Card.

E—618. Air Operated Parts Cleaner—Designed by D. C. Cooper Company, 1467 S. Michigan Ave., Chicago 5, Ill., to eliminate hand cleaning, a pneumatic agitating and dipping machine is especially well suited for automatic cleaning of metal parts, removal of fingerprints from work surfaces, slushing of spare parts in rust preventive oil and greases, and dipping of packages.

Pushing a button causes the rack to be lowered to the bottom of the tank, where it automatically starts agitating. Motion consists of a vertical stroke of approximately 5 inches with a speed of 18–20 strokes per minute, although this may be varied with the requirements of the job.

Both unheated and electric or gas heated units are available. For further information, use Reader Service Card.

E—619. Surface Finishing Machine—A special-purpose Surface Finishing Machine has been announced by Clair Manufacturing Company, 1016 S. Union St., Olean, N. Y. Developed in conjunction with hand-tool manufacturers, this Model



206 Machine can be equipped for either mechanical or magnetic holding. It is recommended for applications where requirements approach a precision grind and, being a versatile contour finisher, is suitable for a wide variety of small metal products, including pliers, wrenches, flat-iron sole plates, pocketknife springs, wrenches, axes, and hinges.

Actuated by an electro-hydraulic system, this machine uses a single spindle upon which a roll 40 inches wide may be mounted. The automatic hydraulic in-and-out stroke is adjustable from 0 to 24 inches, with a maximum holding and working area of 24 x 38 inches. An air circuit provides float of buff at any predetermined uniform pressure. For further information, use Reader Service Card.

E—620. Compressed Air Filters—Offered by the Hanson-Van Winkle-Munning Company, Matawan, N. J., the Ful-flo Air Filter removes rust, scale, dirt, free oil and moisture from compressed-air lines. It is useful for baths requiring air agitation, for lacquer rooms and for work-blowoff purposes, and any other requirements where clean, dry air is important. The filter and replacement cartridges are available from stock in ¾-inch pipe size with mounting bracket.

The air filter does not have to be disconnected from the air line for service; only one nut need be loosened to change the filter element. It operates at pressures up to 125 psi with capacity up to 60 cfm of free air. For further information, use Reader Service Card.

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Easy to apply—can be brushed, dipped or sprayed with equal success.

Possesses rapid air-drying qualities, reducing drying time between coats and in preparation for racking.

Has exceptional adhesive qualities but can be removed easily after plating.

Has good dielectric strength resulting in a clean line of demarcation with no loss of current

Assures extreme accuracy, with no possibility of a lacquer etch on precision-lapped finishes.

Absolutely neutral and will not contaminate any plating solution.

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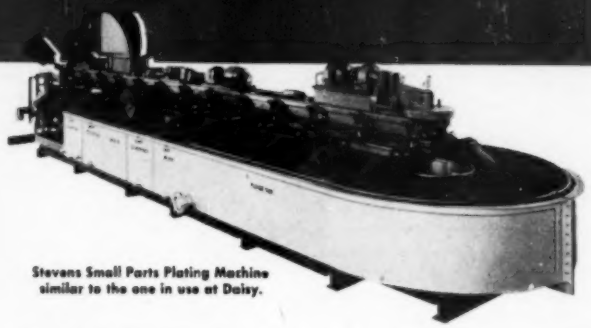
Unplated BB shot is loaded into plating basket by a chute.

After being plated the shot is dumped by the revolving basket.

This tray receives the plated shot and funnels it into a conveyor.

PRODUCTION UP 150%
MAN-HOURS DOWN ONE-THIRD
WITH Stevens
SMALL PARTS PLATING MACHINE AT DAISY MANUFACTURING COMPANY



Stevens Small Parts Plating Machine similar to the one in use at Daisy.

Plating air rifle BB ammunition is an unusual application for a huge plating machine, but the Stevens unit at Daisy Manufacturing Company, Plymouth, Michigan, is bringing new profits and efficiency to this operation. Formerly barrel plating was used to give the pellets their copper coating and it was an unwieldy and laborious process.

But with their Stevens machine Daisy has been able to install an ingenious conveyor system that requires no manual handling from the time the pellets are formed until they are ready for shipping. The pellets are transferred from the shaping machines to a chute and carried by conveyor to the Stevens machine. The machine does the rest.

After plating the shot, the Stevens unit empties it into another chute and a conveyor carries the pellets to automatic packaging machines. Daisy's plating department estimates that production is one and one-half times greater and man-hours are one-third less since installation of their materials handling system built around the Stevens small parts plating machine.

Stevens metal finishing equipment can bring the same benefits to your operation. If you have a plating problem, call in your nearby Stevens representative or write direct to Frederic B. Stevens, Inc., Detroit 16, Mich.

METAL FINISHING EQUIPMENT AND SUPPLIES SINCE 1883

FREDERIC B. STEVENS INCORPORATED

DETROIT 16, MICHIGAN

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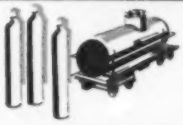

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Editorial

Crises in Materials

ONE OF THE MOST DIFFICULT THINGS in life is to face uncertainty. It takes a very special kind of courage to live in a state of suspense and yet carry on, doing the best possible job under the circumstances. If this is true in the life of an individual, it is even more so in business which depends on efficient planning not only for success but for survival.

The crucial questions which business asks are, "To what extent are civilian goods going to be produced", and "What is going to be done about materials"? All cry out to Washington for answers, but when they will come nobody knows.

However, there seems to be two things that the plater can do in meeting his situation. First, he can see to it that no material goes to waste. The reader's attention is directed to the second reports from the Philadelphia and Springfield Branches in the Branch News section of this issue for several pointers on conservation.

Second, he can learn about the fields of usefulness of substitute materials, remembering that the less essential his product, the more common and more available a material he will have to use eventually. The paper by Knapp and Wesley in this issue falls in that class.

As information on availability comes out of Washington we shall pass it along in these pages. We shall also present, from time to time, proven conservation measures, largely derived from experiences during the last war, and shall furnish data on substitute materials, both old and new.

In the meantime, it is well to remember that uncertainty with its troubles and disappointments is better than all-out war with the heart aches and destruction that accompany it.

Gustaf Soderberg

THE EFFECT OF COPPER UNDERCOATS ON THE PROTECTIVE VALUE OF NICKEL-CHROMIUM COATINGS ON STEEL

B. B. KNAPP* AND W. A. WESLEY*

Summary

Corrosion tests were performed on a limited number of panels of high-carbon steel plated with nickel-chromium and with copper-nickel-chromium coatings. These tests showed that composite coatings containing a considerable proportion of copper were decidedly inferior to copper-free coatings of equal thickness in a normal and a salt-accelerated industrial atmospheric exposure and in a salt-spray test. It was shown, by exposure tests in which the wash from copper and iron screens was permitted to drip onto plated panels, that both copper and iron corrosion products themselves can accelerate corrosion of nickel-chromium coatings. It is postulated that the corrosiveness of copper corrosion products accounts in part for the poor protective value of a copper layer. A thin coating of copper under the nickel exhibited a beneficial effect in the early stages of the atmospheric tests, but this advantage was soon vitiated by the adverse effect of the copper corrosion products.

Introduction

The value of a copper layer in nickel-chromium decorative coatings on steel has been a most active topic of off-the-record debate in the plating industry for several years, being rivalled in popularity only by the question of the merits of salt-spray testing. One school has claimed that copper can be substituted for nickel to the extent of a considerable fraction of the total thickness without impairing the protective value of the coating, basing this statement upon the results of salt-spray tests and field surveys of automobile trim. The other school has claimed that a copper layer cannot be substituted for an equal thickness of nickel without impairing the protective value, and further that the presence of copper is detrimental in some atmospheres.

The incentive to complicate the plating process by introducing a third layer of metal lies in several directions: (1) copper metal costs less than nickel, (2) the overall polishing costs can be lowered by the greater ease of buffing copper as compared with polishing the steel base, and, less importantly, (3) it is believed (but never proved) that better coverage of a steel surface of poor quality is had with copper than with nickel.

Published Work

In the early days faith in the protective value of copper was strong. In 1924 E. M. Baker[1], on the basis of salt-spray-test data, recommended the use of three-layer coatings of nickel-copper-nickel with a total thickness of 1 mil (25 μ). In the following year Thomas and Blum[2] published the results of tests which showed that the presence of a copper layer under the nickel or between two layers of nickel was slightly beneficial to the rust resistance of coated steel as determined by porosity tests, such as the ferricyanide and salt-spray tests, and was markedly beneficial to resistance to the Washington, D. C., atmosphere[3].

Up to this point all was harmonious, and no one paid attention to the distinct evidence of a superiority of nickel-chromium coatings on steel over copper-nickel-chromium coatings in resistance to the Miami, Florida atmosphere which can be found in Phillips' paper on low-*p*H nickel deposition published in 1931[4].

*Research Chemist and Assistant Director, respectively, Research Laboratory, The International Nickel Company, Inc., Bayonne, N. J.

TABLE I. VARIATIONS IN PLATE THICKNESS, PREPARATION, AND EXPOSURE
Steel Base: SAE 1085

Lot No.	Finish	Pre-treatment	Deposit Thickness, mils				Exposure Test			
			Cyanide Copper	Acid Copper	Nickel	Chromium	Bayonne Atmosphere	Accelerated Bayonne Atmosphere	Salt Spray	Hot Water
A1	Cold Rolled	Anodic H_2SO_4	...	...	2.0	0.02	Table V	Table VI	Table VII	
A2	Cold Rolled	Anodic H_2SO_4	...	...	2.0	0.02	Table V*	Table VI*	Table VII*	
A3	Cold Rolled	Anodic H_2SO_4	...	...	2.0	0.02	Table V†	Table VI†	Table VII†	
A4	Cold Rolled	Anodic H_2SO_4	0.1	1.4	0.5	0.02	Table V	Table VI	Table VII	
B1	No. 240 grit	ASTM	0.1	...	0.4	0.02	Table VIII	Table IX		Table X
B2	No. 240 grit‡	ASTM	0.1	...	0.4	0.02	Table VIII	Table IX		Table X
B3	No. 240 grit	ASTM	...	...	0.5	0.02	Table VIII	Table IX		Table X
B4	No. 240 grit‡	ASTM	...	...	0.5	0.02	Table VIII	Table IX		Table X
B5	No. 240 grit	Anodic H_2SO_4	...	...	0.5	0.02	Table VIII	Table IX		Table X

*Panels were exposed to copper corrosion products.
†Panels were exposed to iron corrosion products.
‡Steel panels were allowed to rust after polishing.

The harmony ended when the classic and elaborate series of exposure tests were performed under the joint sponsorship of the National Bureau of Standards, The American Electroplaters' Society, and the American Society for Testing Materials beginning in 1932. In these, copper did not do so well. The general conclusions of these extensive studies at six test sites, representing rural, marine, suburban, and industrial atmospheres, have been ably summarized[5] in the following words:

"The presence of a layer of copper either next to the steel or between two nickel layers reduces the protective value, especially of thin nickel deposits, under severe conditions. If chromium is subsequently applied to the final nickel layer, the presence of a copper layer has very little harmful effect in thick deposits. Buffing of the copper layer increases its protective value".

Although the copper controversy was already beginning, the necessity for specifying an outer nickel layer of minimum thickness was generally agreed upon, as witness the 1935 A. S. T. M.-A. E. S. standard for nickel-chromium coatings on steel[6] which required a total thickness of 0.0007 inch (19 μ) with at least 0.0004 inch (10 μ) of nickel as the layer next to the chromium for general service. By 1945 the requirements for severe service were raised to a total thickness of 0.002 inch (51 μ) with a layer of nickel at least 0.001 (25 μ) thick next to the chromium[7]. Use of copper under the nickel is permissive but not obligatory. Some commercial specifications agree with these requirements, but others do not; for example, a recent automotive company specification requires next to the chromium a minimum nickel layer of only 0.0006 inch (15 μ) for the grade of plated part for which a total coating of 0.002 inch (51 μ) is specified[8]. Again, a copper undercoat is acceptable but not obligatory.

A. S. T. M. Exposure Tests on Plated High Carbon Steel

A serious attempt to settle the copper controversy is being made in the atmospheric-exposure test program of Subcommittee II of A. S. T. M. Committee B8[9]. The purpose of the work is to determine the relative usefulness in typical atmospheres of various composite copper-nickel-chromium electrodeposits as protective and decorative coatings on high-carbon steel of the type used for automobile bumpers. Variables represented in the A. S. T. M. tests include: total plate thickness from 1.0 to 3.0 mils (25 to 76 μ); nickel thickness from 0.5 to 3.0 mils (13 to 76 μ); copper undercoat thickness from 0.1 to 1.5 mils (2.5 to 38 μ); buffing of the undercoat; type of nickel deposit, including bright, semibright and buffed dull nickel; heat treatment of nickel deposits; type of steel base; and six types of atmosphere, namely, industrial, heavy industrial, rural, seacost, semitropical, and an industrial atmospheric test accelerated by periodic wetting of the panels with a solution of sodium chloride.

The A. S. T. M. B-8 subcommittee has not agreed upon the wording of conclusions which might be drawn from the results at the end of 1.5 years' exposure, but the Chairman, H. A. Pray, has published[10]

TABLE II. CLEANING AND PLATING CYCLES—LOT A

Step* No.	Nickel on Steel	Nickel on Copper on Steel	Step* No.	Nickel on Steel	Nickel on Copper on Steel
1	Solvent degrease	Solvent degrease	8	Polish and buff	HCl dip●
2	Wet pumice scrub	Wet pumice scrub	9	Degrease	Acid copper bath*
3	Cathodic alkaline cleaner†	Cathodic alkaline cleaner†	10	Cathodic alkaline cleaner†	Nickel bath[12]◆
4	Repeat No. 2	Repeat No. 2	11	H_2SO_4 dip⊙	Polish and buff
5	Repeat No. 3 for ½ min	Repeat No. 3 for ½ min	12	Chromium bath▲	Degrease
6	Anodic H_2SO_4‡	Anodic H_2SO_4‡	13	Hot water rinse	Cathodic alkaline cleaner†
7	Nickel bath[12]◆	Rochelle copper bath■	14		H_2SO_4 dip⊙
			15		Chromium bath▲
			16		Hot water rinse

*Cold-water rinses between all steps
†7.5 g/l NaOH, 15 g/l Na_2CO_3 at 140° F and 100 asf for 2 min
‡25 per cent by vol H_2SO_4 at 60–70° F, 100 asf for 3 min (passive)
⊙25 per cent by vol H_2SO_4 at 60–70° F for 30 sec
●5 per cent by vol HCl at 60–70° F for 15 sec
◆200 g/l $NiSO_4 \cdot 7H_2O$, 175 g/l $NiCl_2 \cdot 6H_2O$, 40 g/l H_3BO_3 plus 0.4 ml/l.day, 30 per cent H_2O_2 at *p*H 2.0, 115° F, 100 asf
■30 g/l CuCN, 37.5 g/l NaCN (0.7 g/l free NaCN), 30 g/l Na_2CO_3, 45 g/l Rochelle salt at *p*H 12.6–12.8, 140° F, 20 asf
*195 g/l $CuSO_4 \cdot 5H_2O$, 45 g/l H_2SO_4, 3.75 g/l Dacolyte at 110° F, 30 asf
▲250 g/l CrO_3, 2.5 g/l SO_4^{-2} at 113° F, 0.75 asi

his own conclusion as follows: "The plated steel 'bright work' on the exterior of automobiles will retain its decorative value over a longer period of use if the plate includes a liberal thickness of nickel, deposited either directly on the steel or over a copper undercoat. The nickel thickness is the important factor . . .".

The present authors believe that the published data obtained in the A. S. T. M. tests up to 1949 support the following conclusions relating to the effects of a copper layer:

1. In a comparison of coatings of the same total thickness, those which include a substantial fraction of copper have less protective value than those free of copper, the greater the percent copper the poorer the corrosion resistance.

2. In any given location the nickel thickness is the

TABLE III. CLEANING AND PLATING CYCLES—LOT B

Step* No.	Nickel on Steel	Nickel on Steel†	Nickel on Copper on Steel†
1	Wet pumice scrub	Wet pumice scrub	Wet pumice scrub
2	Cathodic alk. cleaner (1)‡	Cathodic alk. cleaner (2)⊙	Cathodic alk. cleaner (2)⊙
3	Repeat No. 1	H_2SO_4 dip▲	H_2SO_4 dip▲
4	Repeat No. 2 for ½ min	Anodic alk. cleaner●	Anodic alk. cleaner●
5	Anodic H_2SO_4◆	HCl dip (2)●●	HCl dip (2) ●●
6	Nickel Bath■	Nickel Bath■	Rochelle copper bath*
7	Buff	Buff	HCl dip (3)◆◆
8	Degrease	Degrease	Nickel bath■
9	Repeat No. 2	Cathodic alk. cleaner (1)‡	Buff
10	HCl dip (1)♦	HCl dip (1)♦	Degrease
11	Chromium bath**	Chromium bath**	Cathodic alk. cleaner (1)‡
12	Hot water rinse	Hot water rinse	HCl dip (1)♦
13			Chromium bath**
14			Hot water rinse

*Cold-water rinses between all steps
†A. S. T. M. procedure
‡7.5 g/l NaOH, 15 g/l Na_2CO_3 at 140° F, 100 asf for 2 min
⊙60 g/l Na_2CO_3, 0.05 g/l soap at *p*H 12–12.5, 180–200° F, 25 asf for 5 min
●60 g/l Na_2CO_3, 0.05 g/l soap at *p*H 12.8–13, 180° F, 20 asf for 2–5 min
◆25 per cent by wt H_2SO_4 at 60–70° F, 200 asf for 1 min (passive)
■330 g/l $NiSO_4 \cdot 7H_2O$, 45 g/l $NiCl_2 \cdot 6H_2O$, 30 g/l H_3BO_3, 0.4 ml/l.day 30 per cent H_2O_2 at *p*H 2.0, 140°F, 50 asf
*30 g/l CuCN, 37.5 g/l NaCN (0.7 g/l free NaCN), 30 g/l Na_2CO_3, 45 g/l Rochelle salt at *p*H 12.6–12.8, 150° F, 20 asf
▲2 per cent by vol H_2SO_4 at 110–120° F for 4 min
♦15 per cent by vol HCl at 60–70° F for 30 sec
●●5 per cent by vol HCl at 105–115° F for 30 sec
◆◆5per cent by vol HCl at 60–70° F for 15 sec
**250 g/l CrO_3, 2.5 g/l SO_4^{-2} at 113° F, 0.75 asi

(*Continued on page 45*)

THE USE OF LEAD IN THE PLATING ROOM

Corrosion Resistance

Lead withstands sulfuric acid (up to 78 per cent), cold hydrofluoric acid, chromic acid, and orthophosphoric acid. The resistance to phosphoric acid is believed to be caused by the presence of small amounts of sulfuric acid introduced during its manufacture from phosphate and sulfuric acid, corrosion difficulties having been encountered with phosphoric acid produced from elemental phosphorus. Lead is also highly resistant to the neutral and acid salts of the same acids and exhibits fair resistance to dilute alkalies.

Nitric acid, fluoboric acid and acetic acid, and their salts, as well as fairly strong alkalies and alkaline salts, attack lead rapidly. No protective films are formed on the lead in their presence and existing films may dissolve. The resistance to chlorides and to hydrochloric acid even in the presence of sulfuric acid is not very satisfactory, lead chloride being fairly soluble.

As a general rule, the higher the concentration of the corrodent and the higher the temperature, the lower the resistance. A high rate of agitation has the same effect, because it prevents the formation of adherent protective films or erodes them if they have formed already.

Platers also make use of another protective film, lead peroxide. It forms at high voltages when lead is made the anode in a solution in which it does not dissolve easily, and it has the property of promoting anodic oxidation of solution constituents. This is utilized in the reoxidation of trivalent chromium in chromic acid plating solutions and, by means of small electrolysis cells, in chromic acid bright dips. The oxidizing ability may also be detrimental; for example, some types of nickel brighteners oxidize at a lead anode.

Formability

The second desirable property of lead is that it can be easily formed. Lead pipes, filled with sand or the like to prevent reduction in cross section, bend easily; lead sheet and lead wire can be shaped into almost any desired form without difficulty. Because lead self-anneals at room temperature, no permanent stresses are established during cold working.

Joining lead to lead by the old process of lead burning is rapid and relatively inexpensive.

Closely allied with the desirable mechanical characteristics of lead are some that are less desirable and limit its applicability. Lead is soft, easily abraded and nicked, and has low fatigue resistance. Lead also suffers from cold flow, e. g., even gravity is sufficient to cause a tank lining to sag if nor properly fastened to the tank. Lead being a low-melting-point metal, even a moderate increase in temperature reduces its mechanical strength and associated properties very markedly.

Lead Alloys

Wherever strength or hardness is a factor, alloyed lead is resorted to. Because good forming characteristics are usually desired, the amount of alloying elements is often limited. The commonly used alloys contain 6–8 per cent antimony, 0.05 per cent tellurium, 7 per cent tin, or 0.10 per cent calcium. The alloys have roughly the same resistance to chemical attack as lead. In some instances, however, differences in corrodibility may be of some importance; for example, tin-lead alloy makes a better anode than antimony-lead alloy in chromium plating solutions, especially those containing fluorine compounds. In the following both lead and lead-alloys will be referred to as lead.

A special alloy containing about 1 per cent silver shows greatly improved resistance to solutions containing hydrochloric acid or chlorides, but it is seldom used in the electroplating plant.

Sometimes alloy constituents and impurities in the lead segregate, and then the lead becomes liable to corrosion pitting and rapid local penetration. Lead-burned seams in chromium plating tanks suffer at times from this malady, and coils in chromium plating baths may perforate under the influence of stray currents.

Applications

Piping, pipe fittings, valves and pumps are made either of solid lead or of lead-lined steel, and tanks and filters are lined with lead.

All these items serve well for electropolishing and electrolytic acid treatment of steel in solutions of mixed phosphoric-sulfuric acids (60–80 per cent by weight at 120–170° F) or straight sulfuric acid (30–60 per cent by volume at 85–120° F). This includes lead-lined operating and storage tanks and lead-pipe coolers of the water-drip-and-air-blast type and of the immersed-coil type. As is usual, the bottom of operating tanks is protected from mechanical damage with a layer of acid-proof brick.

The same can be said of lead equipment for anodizing of aluminum in sulfuric or chromic acid, although straight steel is commonly used for the latter process.

Lead-lined sulfuric acid-dip tanks are common and satisfactory. In the past such tanks have also been employed for hydrochloric acid and mixtures of hydrochloric and sulfuric acids, but the limited corrosion resistance imparted by the chloride ion and the dragin of lead compounds into subsequent plating tanks have caused platers to turn to other linings. Lead-lined rinse tanks for sulfuric acid or sulfate solutions serve satisfactorily.

Lead equipment has also been used with various acid plating solutions, including nickel, acid copper and acid

(*Continued on page 57*)

leaders in the industry xxx

Ralph A. Schaefer

DR. RALPH A. SCHAEFER was born on August 16, 1913 near the town of Grafton in northeastern Ohio and spent his boyhood working on his father's dairy farm. His graduation from Grafton High School and from the farm occurred simultaneously.

In the early thirties he enrolled at the University of Notre Dame and began studying chemical engineering, but the depression prevented him from completing his studies at South Bend. Later he transferred to Western Reserve University in Cleveland and continued his education on a part-time and full-time basis while working at odd jobs. He received a Bachelor's degree in 1935 and Master of Science degree in 1936.

In the spring of 1936 he joined the laboratory staff of Cleveland Graphite Bronze Company in Cleveland, Ohio, as an analytical chemist and has been with that company ever since. He progressed steadily and became Director of Research in 1945. In the meantime he had continued his studies at Western Reserve University and received a Doctor of Philosophy degree in 1941.

To start with, his activities at Graphite were concerned with straight metallurgical developments in the production of composite bimetal and trimetal bearings, metal cleaning, pickling, fluxing and casting on a continuous basis. He also worked in the field of powder metallurgy on clutch plates and friction elements, which were used in large volume by the aircraft industry during the war.

In 1940, his company embarked on an extensive research program to investigate electrodeposition as a fundamental process for bonding bearing materials to steel. Schaefer was chosen to captain the venture, and because of this introduction to electrochemistry, he likes to consider himself a practical electroplater who entered the field by way of the back door. He was responsible for much of the early research and development work on heavy silver- and alloy-overlay plated bearings. These plating processes have been particularly successful in engineering applications.

Dr. Schaefer is the author or coauthor of a substantial number of articles and the recipient of many patents, all dealing directly or indirectly with bearings, a field in which he is considered an authority. Of general interest are contributions dealing with analysis of silver strike solutions and with engineering for obtaining uniform plate distribution.

Dr. Schaefer is a member of a large number of such technical organizations as American Chemical Society, American Institute of Mining and Metallurgical Engineers, Electrodepositors' Technical Society, American Society for Metals, Society of Non-Destructive Testing, and Sigma Xi. He has been active on Committee B-8 of American Society for Testing Materials. In the Electrochemical Society he has been a member of the Board of Directors and has held various offices, including chairmanships of both the Electrodeposition Division and the Cleveland Section.

In the A. E. S. he is a past president of the Cleveland Branch. He was a member of its Research Committee during 1946–1949, has been Chairman of Project Committee No. 11 since its inception, and is at present Vice-Chairman of the Research Directing Subcommittee. He has also served as an Associate Editor of PLATING for the past three years.

His hobbies are chiefly confined to an occasional auto trip with his wife and three children.

THE HISTORY OF NICKEL PLATING DEVELOPMENTS IN THE U.S.A.

This year, 1951, marks the 200th anniversary of the isolation and naming of the element nickel by the Swedish scientist, Axel F. Cronstedt. Whereas nickel in natural alloys had been used for many centuries prior to 1751, the advent of electroplating in England in the early 1840's brought forth the first practical use for nickel metal.

Although the consumption of nickel for plating has been exceeded by its application in nickel alloy steels and high-nickel alloys in the past half century, the plating industry continues to account for a large proportion of the total consumption of this metal. It is estimated that 18 per cent of the total nickel produced in 1949 was employed by the plating industry, and all evidence seems to indicate that this industry will continue to be an important consumer of nickel for many years to come.

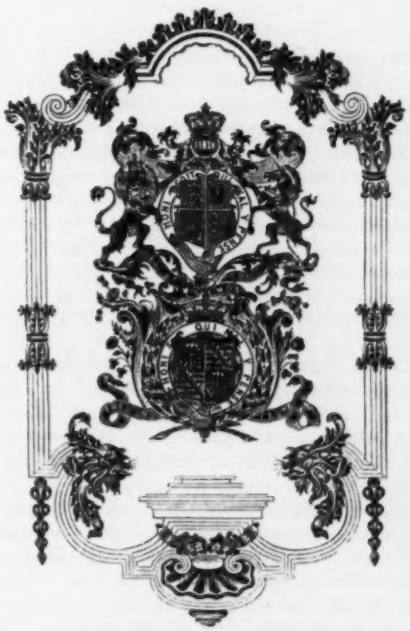
R. J. McKAY

The International Nickel Company, New York, N. Y.

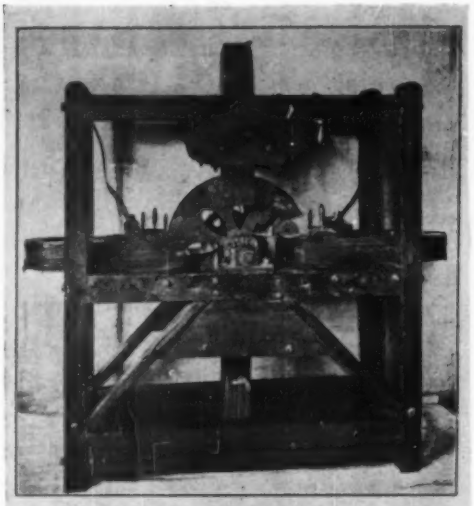
The electroplating industry and the use of nickel in plating have grown with remarkable rapidity in recent years. It is estimated that, aside from strip-plating operations of large steel producers, which are considered a special case, nickel plating now represents 75 per cent of the plating industry. With steel-making as the principal use of nickel in the production of both strong-and-tough alloys and corrosion-resisting stainless varieties; and high-nickel alloys, including Monel, Inconel, and malleable nickel, as the second; nickel plating runs a close third with a total tonnage last year of nearly 20,000 short tons (18,000 metric tons) consumed in America and Europe. The more than 250 per cent increase in nickel plating in United States and Canada during the last decade in spite of wartime limitations has been about twice as rapid as the rise in general industrial production, according to the Federal Reserve Index, and one and a half times the increase in the overall consumption of nickel, according to Bureau of Mines statistics. The increase in nickel plating, so far as the nickel industry is concerned, is exceeded only by the increase in stainless steel production, which has been more than quadrupled.

In view of this rapid growth, it has seemed a good idea in 1951, when the 200th anniversary of the discovery of the element nickel is being celebrated, to look into the history of the growth of the nickel-plating industry and possibly form from past records and present developments some idea of what the future may hold.

This resume of old and new developments presents only those salient points of older happenings which have had a lasting effect on the industry. As it reaches the present where our perspective is likely to be warped by our nearness to the subject, it makes some guesses as to the effect of the activities and ideas with which the industry is now occupied.



Reproduction of wood cut of British Royal Arms by means of electrotype, made in 1842 for backs of playing cards. Reproduced from Smee's Elements of Electro-Metallurgy, which states that "First packs were graciously accepted" by Queen Victoria



THE FIRST ELECTRO-PLATING MACHINE NOW IN ASTON HALL, BIRMINGHAM, ENGLAND.

The famous Woolrich machine which was used for silver plating in 1844. Reproduced from Metal Industry, courtesy Finishing Publications, Inc.

The purpose is to stimulate some thought on the past, present, and future of electroplating as a versatile method of working metal. No comparisons are attempted between the values of the contributions of individuals and organizations, but some developments which have had an enduring, constructive effect on the plating industry are designated as "*milestones*". The plan is to cover the area where discovery and invention has affected or been affected by commercial development, rather than either the predominantly technical or commercial phases.

Older Work

Technical experience with electroplating began almost with the beginning of knowledge of the electric current, or "fluid". After many centuries of acquaintance with the electric static charge, as represented by the effect of rubbing of amber, and relatively soon after Franklin (1752) had drawn the charge from clouds, Galvani in the late 1700's and Volta in 1800 demonstrated that electricity can be generated through "galvanic" contact between two metals. In the same year, 1800, as Volta published his work, Nicholson and Carlisle decomposed water into hydrogen and oxygen gas by means of the electric "fluid" and Cruikshank decomposed metallic salts and deposited copper at one electrode.

In 1812, Sir Humphrey Davy, even then recognized as the foremost scientist of his time, hired Michael Faraday, a completely unknown nineteen-year-old, to work in his laboratory at 25 shillings per week. Something of the state of the general knowledge and thought of these years is obtained by a study of the *Chemical Catechism* by Samuel Parkes, published in New York in 1821. Note that this work was in the form of a "catechism", reflecting the strong influence of the religious principles of the times. Referring to Davy's Bakerian Lecture, published in *Philosophical Transactions of the Royal Society*, 1807, Parkes says:

"The experiments of Sir Humphrey Davy . . . have thrown considerable light on the agencies of electricity and galvanism. . . . From these and similar results, it appears that 'hydrogen, the alkaline substances, the metals, and certain metallic oxides are attracted by negatively electrified metallic surfaces, and repelled by positively electrified metallic surfaces; and contrariwise, that oxygen and acid substances are attracted by positively electrified metallic surfaces and repelled by negatively electrified metallic surfaces; and these attractive and repulsive forces are sufficiently energetic to destroy or suspend the usual operation of elective affinity.' Sir H. Davy concludes this most important paper by suggesting that this new method of decomposition may, *probably, be introduced with advantage into manufactures;* and imagines that he shall be able to refer several natural phenomena to this source, which have hitherto been inexplicable".

In 1831, Faraday for the first time generated current mechanically by rotating a copper disc between the poles of a magnet and, about 1833–1835, proposed his well known "laws". Hence it seems that the ability of the electrical current to decompose metal salts was understood before the possibility of mechanical generation was known, but the improvement and knowledge of the possibilities of generators and of the reverse effect in motors seem to have far outstripped the knowledge of electrochemistry and of metal deposition, probably because of their more direct application to practical human affairs.

Franklin was the first to put his knowledge of electricity to use in his invention of the lightning rod. This pioneering but rather negative application, prevention of damage, seems dwarfed by the first positive use of the current through telegraphy, invented in the United States by Henry and by Morse in 1836 and by workers in Germany and England in the same year.

The beginning of practical use of electrodeposition was apparently in gilding and silver plating by the Elkingtons of Birmingham, England. They obtained assignments of patents from some inventors and collaborated with others, notably John Wright, in patenting a number of processes for plating or coating metals, including the use of electric current for depositing silver. One of their acquired processes was for bright plating; another, the Woolrich process, included magneto-electric generation. By about 1840–1843 the Elkingtons were manufacturing various silver plated articles.

The first "strictly electrometallurgical patent" is stated by Smee in his *Elements of Electrometallurgy*

(1843) to have been granted to James Shore of Birmingham, in 1840. This patent claimed "the coating of . . . cast iron, lead, and copper . . . with copper or nickel . . . by galvanic electricity". Boettger, in Germany, described the nickel ammonium sulfate bath in 1842. Smee also mentioned the use of nickel "ammonio-sulfate" as a preferred compound for the reduction of nickel and for plating.

At the time of Smee's publication no practical application had been proposed for plating or for electrometallurgy. Some extracts from his book illustrate the state of mind prevailing at the time. It is obvious that the pursuit of electrometallurgy and electroplating was considered mainly as an avocation to be followed by amateurs. On page 226 we find the following statements which are both enlightening and amusing:

". . . to those who follow galvanic science as an amusement, the exercise of the arts of gilding, plating and coppering will not only be interesting, but useful; in the arts doubtless they will assume a higher importance, and add new branches for the successful application of electricity. Those who are desirous of following these processes as a business . . .

"To the young chemist, we would particularly recommend the study of this science, and should he be tempted to turn his attention to it in a systematic manner, he will be amply rewarded for his trouble. The results of his experiments are lasting, and will be contemplated by him in after years with pleasure; whereas chemistry, being too often used as a source of amusement, brings forth very different results. The experiments tend to nothing, and end in nothing, beyond the present gratification; . . ." and on the next page the statement, no doubt startling at the time, that:—

"There are other purposes besides electrometallurgy for which the galvanic force is applicable to the wants of mankind" . . . (!)

The following statements appear in the introduction:

"There is not a town in England that I have happened to visit, and scarcely a street of this metropolis, where prepared plasters are not exposed to view for the purpose of alluring persons to follow the delightful recreation afforded by the practice of electrometallurgy", and

"No person can now plead ignorance of electrometallurgy as an excuse for not following it. There are such a variety of works upon the subject to suit every class of persons, from a penny up to three or four shillings, that certainly he must be enabled to purchase one according to his means. . . ."

As a physician Dr. Smee was interested in the bodily as well as the mental health of the prospective "electrometallurgist", for we also find these passages:

"As a surgeon I feel bound to pass my opinion upon the effect which an extensive application of electrometallurgy would have on the health of the workman; and in one word I may state, that I believe the mode of working in metals by the galvanic fluid is more wholesome, and attended with far less deleterious properties, than the methods now practiced. . . . Those conducting electrometallurgical operations generally fatten with their occupation, the minute quantities of zinc and sulphuric acid which they imbibe improving the tone of their stomach, helping digestion, and strengthening the whole frame. . . ."(!)

Reproduction of wood cut by means of copper electrotype, made about 1842. Reproduced from Smee's Elements of Electro-Metallurgy. Many electrotypes are now faced with nickel

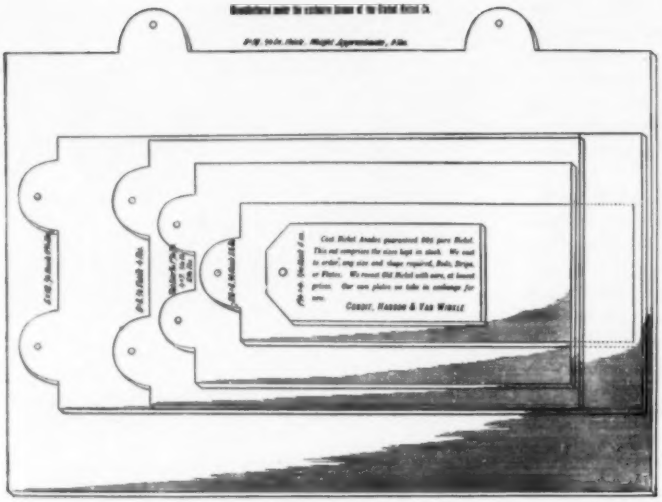
As to more serious facts of history, Dr. Smee says:

". . . electrometallurgy comprising electro-gilding and plating received great impulses from Elkington . . . he was anticipated by Brugnatelli . . . he [Brugnatelli] gilt in a complete manner two large silver medals, by bringing them into communication by means of a steel wire, with the negative pole of a voltaic pile, and keeping one after the other immersed in ammoniuret of gold newly made and well saturated. [*Phil. Mag.* for 1805]. . . . This process . . . doubtless ought to be considered as the introduction of electrometallurgy, being the first instance in which any metal was ever reduced by galvanism for the purposes of the arts".

Dr. Smee describes a serious attempt which was being made at the "dock-yard at Portsmouth" to cover the bottoms of ships with copper by "electrocoppering" and gives as his opinion that "The cost of the reduction of copper when added to the labour required for the process will not at all compensate for the additional time that the reduced copper would last over the copper sheathing as usually employed".

Finally, in discussing nickel, Smee says:

"Nickel is the last on the list of noble metals, being the most ignoble of that class . . . . The nitrate of nickel is very soluble but the metal has no great inclination to be precipitated for the hydrogen appears rather to prefer being envolved than to reduce the metal. . . . When we employ either the nitrate or sulfate of nickel for electrometallurgy, it is preferable to use the solution as strong as possible. Of the compounds of these salts with the alkalies, those of am-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CONDIT, HANSON & VAN WINKLE

Early nickel-anode designs of Condit, Hanson & Van Winkle

monia deserve the preference, and the ammonio-nitrate, and the ammonio-sulfate may be used for the reduction of this rather troublesome metal". And

"Metals may be covered with nickel, but proceeding as in former cases. The solution to be used is the chloride of nickel with a nickel positive pole. The single battery process is to be preferred, but pure nickel, though very brilliant, is apt to be rather brittle".

FIRST MILESTONE—Commercial plating with cast anodes and double-salt bath

The first commercial nickel plating seems to have been done in Boston by Isaac Adams, in 1865. His patent of that year claimed a nickel plated cast-iron gas tip. In 1869 he patented the double-salt bath and a year or so later a cast-nickel anode and also one containing carbon. Adams also was educated as a "surgeon" and was the son of a "surgeon". Apparently Adams, senior, did not agree with Dr. Smee as to the salutary effects of electrometallurgy, for when Isaac, Jr. spent his time at it instead of duly practising his profession, his father disinherited him. Here again we can gain some instruction and entertainment by referring to Adams' own account of the early plating operations, published in 1905. It is necessary first to explain that William H. Remington had taken out a patent on nickel plating in 1868 which covered plating from a "grain" nickel anode in a chloride bath. This antedated Adams' patent on the double-salt bath, but the process never operated well. The difficulty was apparently the presence of nitrates, and there was no indication that the trouble had been diagnosed when Adams took over and introduced the double-salt bath. Following are extracts from Adams' paper:

"Fifty years ago. . . . The published works of Smee and Gore in England, Roseleur in France, Elsner in Germany, and a few others whose names I cannot recall, represented all that was known of the practical or industrial art of electrochemistry. Compared with what there is known today, one might say that the art did not exist at all.

"The first commercial nickel plating, so far as I am aware, was carried on in a small room on Fourth Street, Boston. . . . I commenced operations with about twenty gallons of solution and with cast nickel anodes.

"The next attempt to place nickel plated goods on the market was made in the winter of 1868–1869 by Wm. H. Remington, under the firm name, as I recollect it, of Wm. H. Remington and Co., the company, in this case being a lady well known in spiritualistic circles, and herself claiming to be a medium. Mr. Remington, who had had some experience in electrotyping, represented in the firm the 'skilled in the art' man, while the role of the lady partner was, in some mysterious way, to control all baneful spirit influences and, if possible, to filch from some unsuspicious spirit, bits of information and knowledge which might be of use to the firm and which could be obtained in no other way. . . . Mr. Remington's shop was located in Province Street, Boston, Mass., and was well stocked with the solutions and tools necessary to the business. . . . .To make a long story short, I was called in to straighten matters out. Mr. Remington, in the attempt to render his solutions more efficient, used numerous 'dopes' mostly of vegetable origin, and with spirit advice. The last 'dope' tried was an aqueous infusion of skunk cabbage. The Province Street shop was reorganized and called The Boston Nickel Plating Co. and under that name it exists today. . . ."

(*Continued on page 57*)

Continued from page 38)

only variable studied in these tests which exerts an important influence on the atmospheric-weathering characteristics of the coatings.

3. When the results in all the atmospheres represented are considered, buffing of the copper undercoat shows no consistent effect upon protective value.

4. Use of a thin "flash" copper coat directly upon the steel has a slight beneficial effect in the industrial atmospheres.

Purpose of Present Study

The corrosion tests and atmospheric exposure tests which are to be described were begun a full year before the A. S. T. M. program discussed above. The object was to observe the effects of flash and heavier copper undercoats upon the rust resistance of nickel-chromium decorative finishes on steel while at the same time attempting to test a theory postulated in 1945 by one of the authors (WAW) that the corrosion products of copper are themselves corrosive to nickel-chromium coatings. This theory, if true, would help explain why copper is not equivalent to nickel in such coatings. The accelerating effect of soluble salts of copper upon the corrosion of nickel and other metals in acid solutions has long been known and might be expected to play a part in the corrosion of nickel-chromium coatings with copper undercoats exposed in atmospheres containing sulfur dioxide. In a pure marine atmosphere or in the salt spray the liquid phase is neutral in reaction, and copper corrosion products would be insoluble, hence harmless.

By the same reasoning one might expect iron corrosion products to be corrosive to nickel so that the behavior of plated steel parts would be poorer around unprotected edges, drilled holes, or other local sources of rust. Accordingly, some experiments were also planned to determine the effects of iron rust on the protective value of nickel-chromium coatings.

Plan of the Tests

The list of panels prepared for corrosion tests is given in Table I, which also shows the variations in plate thickness, preparation of test panels, and types of exposure tests planned. Panels in Lots A1 and A4 were designed to show the effect of replacing a large proportion of the nickel with copper. The effects of corrosion products were to be learned from panels in Lots A2 and A3, which were to be exposed outdoors with a portion of copper or iron wire screen mounted over the upper half of each panel so that as these corroded the copper or iron corrosion products would drain over the plated surface. Panels in Lots B1 and B3 were to be plated with and without a flash of copper under the nickel to determine the alleged beneficial effect of a thin copper undercoat upon the protective value of the nickel-chromium layers. Because this effect might be more pronounced on a poor steel

TABLE IV. METHOD OF RATING PLATED EXPOSURE TEST PANELS

Rating Number	Range of Percent Area Defective
10	None
9	0.0–0.010
8	0.10–0.25
7	0.25–0.50
6	0.50–1.0
5	1.0–2.5
4	2.5–5.0
3	5.0–10
2	10–25
1	25–50
0	50–100

Abbreviations Describing Defects

Types of Failure

R —Corrosion (rusting) of the basis metal. Permanent or massive type of basis metal corrosion such as that in pinholes, base or flaked areas, or in craters of broken blisters
Rs—Stain due to basis metal corrosion products, such as rust stain, which can be removed readily with a damp cloth or chamois and mild abrasive revealing a sound bright surface
S —Stains or spots other than that of obvious basis metal corrosion products
Sp—Surface pits. Corrosion pits probably not extending through to the basis metal, i. e., absence of obvious basis metal corrosion products bleeding therefrom
F —Flaking or peeling of deposit
B —Blistering
C —Cracking
Z —Crazing
W—Crow's feet

Degree or Extent of Pinhole Rusting, Staining, Surface Pitting, Flaking, etc.

vs—very slight amount
s —Slight amount
i —Intermediate or moderate amount
x —Excessive amount

Description of Blisters or Crater Rust Spots

s —Less than about 0.5 mm in diameter
i —About 0.5–2.0 mm in diameter
x —Larger than about 2.0 mm in diameter
vf —5 or fewer
f —5–10
i —10–25
m —25–50
vm—Over 50

Adjectival Descriptions of Kind or Type and Location of Defect

p—pinpoint
c—crater
b—blotchy
e—edge
g—general

TABLE V. BAYONNE ATMOSPHERIC EXPOSURE OF PLATED PANELS

Lot No.	Plate Thickness, mils		Exposure Conditions	Rating and Description*		
	Cu	Ni		3 months	9 months	18 months
A1	...	2.0	Normal	4 xvsSp	2 xvsSp, spR	1 xvsSp, spR
A2	...	2.0	Copper wash	3 xvsSp, fscR	2 vxsSp, spR mscR	1 xvsSp, vmscR
A3	...	2.0	Iron wash	3 xvsSp	1 xvsSp, spR	1 xvsSp, ipR
A4	1.5	0.5	Normal	3 xvsSp	2 xvsSp, spR vmsB	1 xvsSp, iscR vmiB

*xvsSp—excessive amount of very small surface pits
spR, ipR—small, intermediate amount of pinhole rust spots
vmsB—more than 50 blisters less than 0.5 mm in diameter
vmiB—more than 50 blisters less than 2.0 mm in diameter
fscR, iscR, mscR, vmscR—less than 5, 10–25, 25–50, more than 50 crater rust spots less than 0.5 mm in diameter

surface than on a good one, the steel-base panels for Lots B2 and B4 were to be permitted to rust before they were cleaned and plated. Panels in Lot B5 were to serve as controls representing a perfectly clean steel surface by giving them an anodic sulfuric acid treatment prior to electroplating.

Several types of corrosion tests were planned. Primary reliance was to be placed on normal exposure to the Bayonne atnosphere, but the salt-accelerated atmospheric exposure method devised by Phillips and Clifton[3] was also included to simulate the effects of use of salt on city streets in the winter. Standard salt-spray tests were planned for the heavier coatings of Lots A1–A4 while hot-water tests would replace these tests in the case of the lighter coatings of Lots B1–B5.

Preparation of Test Panels

Lot A.—The base material used for all panels was SAE 1085 steel in the form of ⅛ × 4 × 6-inch plates. In as much as the anodic sulfuric acid pretreatment was to be used, that obviated polishing the steel. The nickel deposits were finished by hand; first, by polishing on a belt grinder with 500-grit abrasive and then by buffing with lime. The thickness of coating was measured on each panel by means of the Magne-Gage or microscope and was controlled within ± 10 per cent. The sequence of steps in the cleaning and plating cycles for the all-nickel coating and the copper-nickel coating on steel is given in Table II. The solution compositions and operating conditions are also included.

Lot B.—The base material used for this lot was the same as that used for Lot A. The steel was polished by hand on No. 240 grit belts. Half of the number of panels were allowed to rust after polishing simply by exposing them to the plating laboratory atmosphere until they had been covered completely. The steps in the cleaning and plating cycles are given in Table III along with the solution composition and conditions of use. The thickness of nickel on each panel was checked with the Magne-Gage and was kept at 0.0005 ± 10 per cent. Readings were made on the composite coatings of copper and nickel to serve only as a check against gross errors and bad distribution.

TABLE VI. ACCELERATED BAYONNE ATMOSPHERIC EXPOSURE OF PLATED PANELS

Lot No.	Plate Thickness, mils		Exposure Conditions	Rating and Description*		
	Cu	Ni		3 months	9 months	18 months
A1	...	2.0	Normal	4 vseZ, xvsSp	2 xvsSp, vspR	0 xvsSp, iicR, spR
A2	...	2.0	Copper wash	3 xvsSp, spR vfscR, fsB	1 xvsSp, ipR, iicR, fsB	0 xvsSp, sRs, vmxcR
A3	...	2.0	Iron wash	3 xvsSp	1 xvsSp, vspR	0 xvsSp, sRs, mxcR, spR
A4	1.5	0.5	Normal	1 xvsSp, vseZ, vfscR, fsB	0 vmsB, vmscR	0 vmxcR, xRs

*vseZ—very small amount of edge crazing
xvsSp—excessive amount of very small surface pits
vfscR, vmscR—less than 5, more than 50 crater rust spots less than 0.5 mm in diameter
iicR—10–25 crater rust spots 0.5–2.0 mm in diameter
mxcR, vmxcR—25–50, more than 50 crater rust spots larger than 2 mm in diameter
fsB, vmsB—less than 5, more than 50 blisters less than 0.5 mm in diameter
vspR, spR, ipR—very small amount, small amount, intermediate amount of pinhole rust spots
sRs, xRs—small, excessive amount of rust stain

TABLE VII. SALT SPRAY EXPOSURE OF PLATED PANELS*

Lot No.	Coating Thickness, mils		Exposure Conditions	Time, hours	Appearance
	Cu	Ni			
A1	...	2.0	Normal	114	No rust spots; some slight craze cracking could be seen on the edges under a microscope
A2	...	2.0	Copper wash	114	No rust spots or stain; some craze cracks on edges
A3	...	2.0	Iron wash	114	Nickel pitted under the iron screen
A4	1.5	0.5	Normal	114	About 100 small spots of rust stain
A1	...	2.0	Normal	535	No rust spots; some craze cracking on the edges
A2	...	2.0	Copper wash	535	One rust spot at edge of screen and two under screen; deep pits in the nickel at the edge of screen
A3	...	2.0	Iron wash	535	Nickel pitted by many elongated pits both under screen and about 1 inch below it
A4	1.5	0.5	Normal	535	Many rust stain spots, about 10 per sq in
A1	...	2.0	Normal	1500	No rust spots; craze cracks at edges
A2	...	2.0	Copper wash	1500	Five rust spots under screen near edge; considerable corrosion of nickel around rust spots
A3	...	2.0	Iron wash	1500	Nickel pitted over entire surface, very severely under the screen
A4	1.5	0.5	Normal	1500	Three large rust spots and one blister; many small rust stain spots

*Condition of test conformed to A. S. T. M. Specification B117 except that the fog condensate was about 10 per cent instead of 20 per cent salt, in spite of the fact that the supply of salt solution was of 20 per cent concentration.

Details of Corrosion Tests

Normal and accelerated atmospheric exposure

These tests consisted of a normal atmospheric exposure and an accelerated atmospheric exposure obtained by spraying with a 10 per cent sodium chloride solution three times weekly. The tests were made in the laboratory exposure yard at Bayonne, N. J. This site is not far from the center of oil-refinery activity and only one block from the Central Railroad of New Jersey tracks. The specimens were mounted on metal racks of the type used by American Society for Testing Materials and American Electroplaters' Society[11]. The racks were inclined 30 degrees from the horizontal and faced south. The final inspection method used in examination of the panels was the system devised by the A. S. T. M. Committee B-8, Subcommittee II[9]. Unfortunately, this system was not available at the start of the tests. It consists in assigning to each panel a rating number based on percentage defective area and a shorthand description of the type of defect and its extent. The rating number is obtained by comparison with a set of photographic standards with a known percentage defective area. The range of defective area for each rating number and the system of abbreviations is given in Table IV.

The panels of Lot A were exposed in triplicate, and one set was removed for detailed examination after

TABLE VIII. BAYONNE ATMOSPHERIC EXPOSURE OF PLATED PANELS
Exposure period: 11–1–46 to 10–30–47

Panel No.	Coating Thickness, mils			Base Rusted	Pretreatment	Numerical Rating*				ASTM Rating, 1 yr	Shorthand Description after 1 yr†
	Cu	Ni	Total			26 days	77	157	238		
B1	0.1	0.4	0.5	No	ASTM	1	4	4	2	0	xRs, ieZ, vmscR
B2	0.1	0.4	0.5	Yes	ASTM	3	5	5	2	0	xRs, ieZ, vmscR
B3	...	0.5	0.5	No	ASTM	4	2	3	1	1	iRs, ieZ, xpR
B4	...	0.5	0.5	Yes	ASTM	5	1	1	1	1	iRs, ieZ, xpR
B5	...	0.5	0.5	No	Anodic H_2SO_4	2	3	2	1	1	iRs, ieZ, xpR

*Numerical rating is simply the order of merit of the panels at time indicated in days
†iRs, xRs—intermediate, excessive amount of rust stain
ieZ—intermediate amount of edge crazing
xpR—excessive amount of pinhole rusting
vmscR—more than 50 crater rust spots less than 0.5 mm in diameter

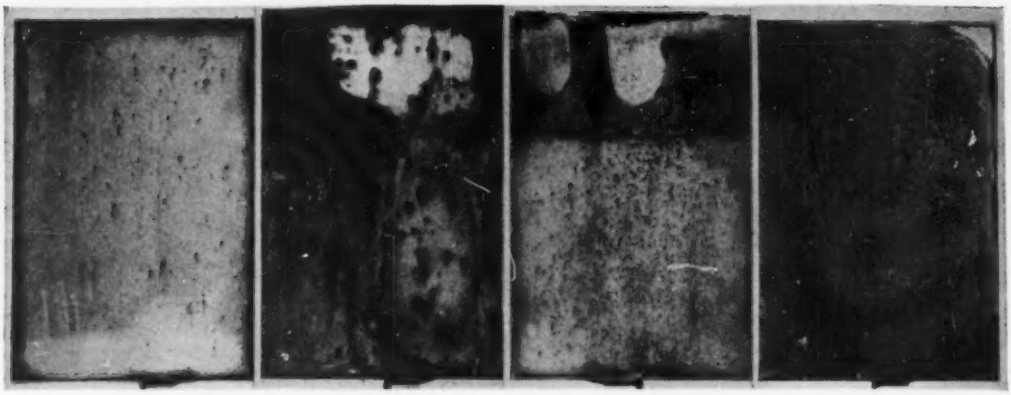

Fig. 1. Typical panels from Lot A after 18 months' atmospheric exposure in Bayonne, N. J. 0.4 X. From left to right: 0.002-inch nickel, normal exposure (A1); 0.002-inch nickel, exposure to copper corrosion products (A2); 0.002-inch nickel, exposure to iron corrosion products (A3); 0.0015-inch copper plus 0.0005-inch nickel, normal exposure (A4)

3, 9, and 18 months' exposure, respectively. The rating and description given in Tables V and VI are for cleaned panels. Mild abrasive cleaning with wet pumice on a plater's brush was necessary to remove copper and iron corrosion products so that damage to the surface could be assessed.

The panels of Lot B were exposed in duplicate. The rating and description of the panels in Tables VIII and IX were made without cleaning.

Salt-Spray Test

The panels in this test were mounted on a Monel-metal frame with porcelain spacers. The frame was placed at a 60-degree angle from horizontal in a salt-spray chamber. The conditions of the test conformed to A. S. T. M. Specification B117, except that the fog condensate was about 10 per cent instead of 20 per cent, in spite of the fact that the supply of salt solution was of 20 per cent concentration. The panels were exposed in triplicate, and one set was removed for examination after 114, 535, and 1500 hours. Because the corrosion was slight and irregular in this test, the A. S. T. M. rating system was not used. The appearance of the panels is described in Table VIII.

Hot-Water Test

This test is one that has been employed for detecting porosity of nickel plated steel. It consists of complete immersion in agitated carbon dioxide-saturated water at 180° F (82° C) for a period of 3 hours. The

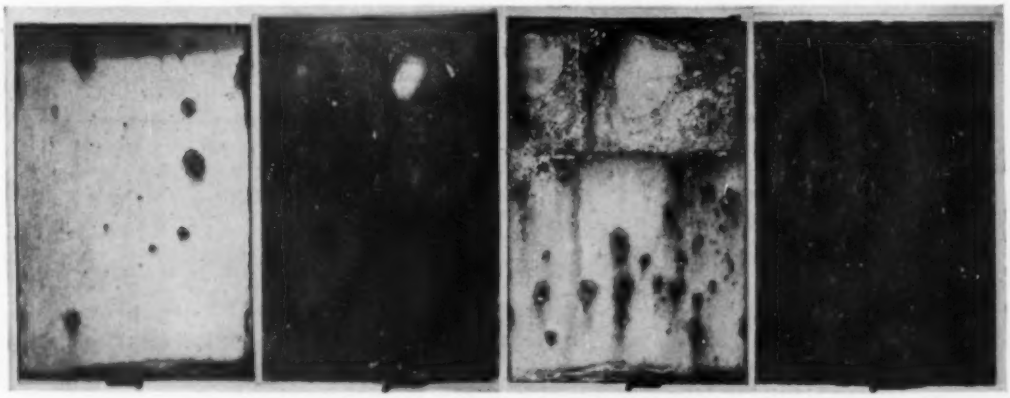

Fig. 2. Typical panels from Lot A after 18 months' accelerated atmospheric exposure in Bayonne, N. J. 0.4 X. From left to right: 0.002-inch nickel, normal exposure (A1); 0.002-inch nickel, exposure to copper corrosion products (A2); 0.002-inch nickel, exposure to iron corrosion products (A3); 0.0015-inch copper plus 0.0005-inch nickel, normal exposure (A4)

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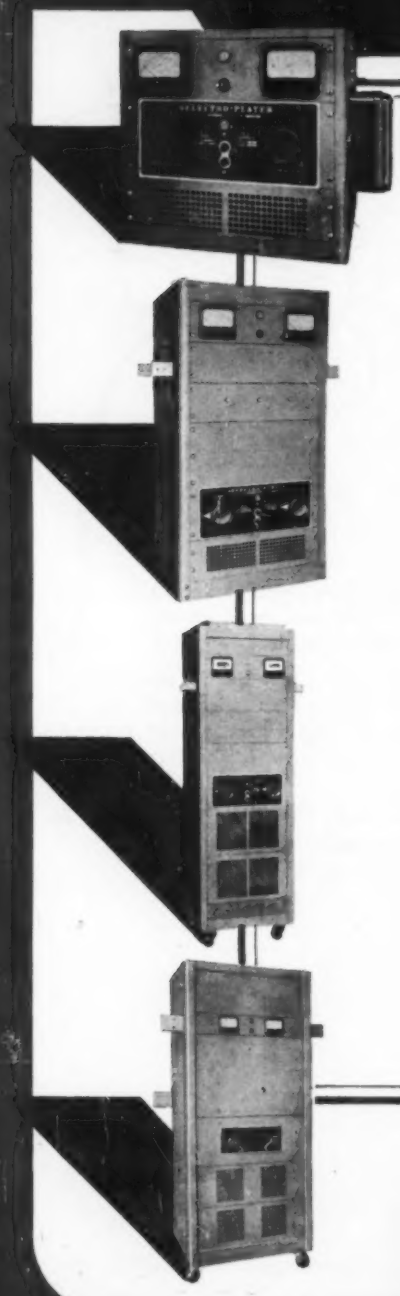

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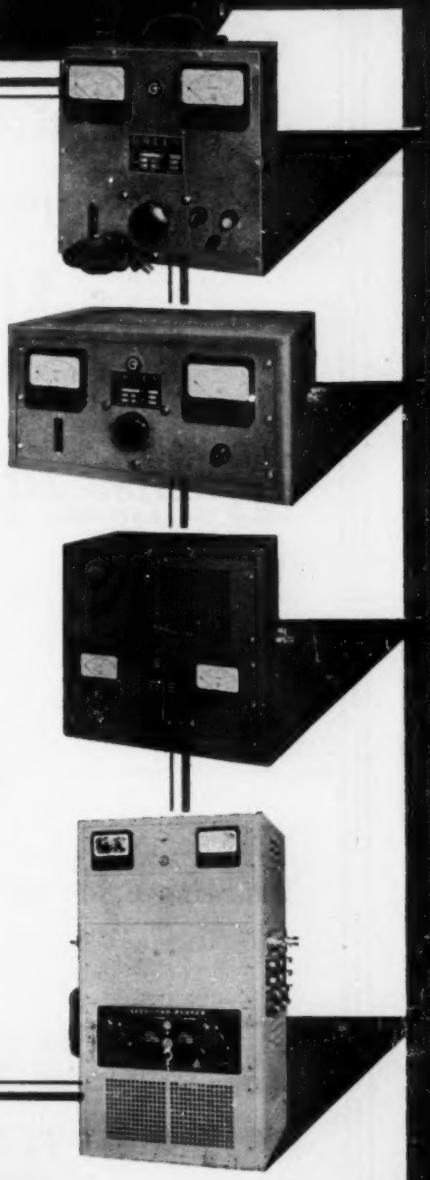

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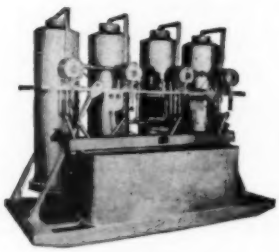

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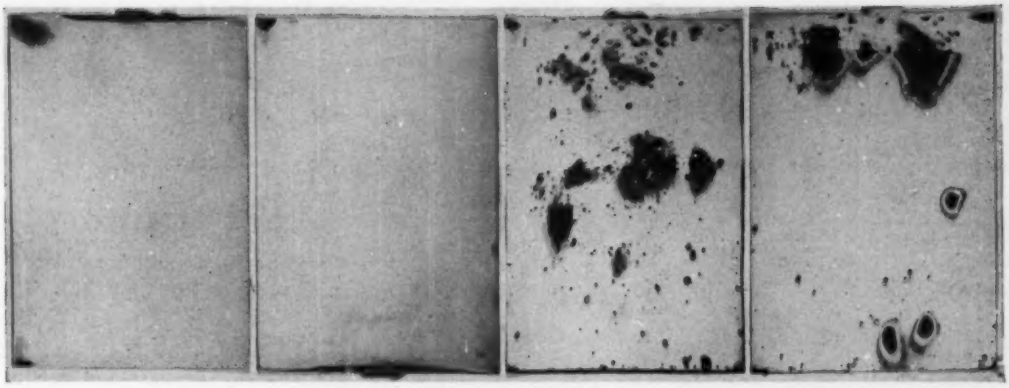

Fig. 3. Panels from Lot B after 216 hours' hot-water test. 0.36X. From left to right: 0.0001-inch copper plus 0.0004-inch nickel, base not prerusted (B1); same, base prerusted (B2); 0.0005-inch nickel, base not prerusted (B3); same, base prerusted (B4)

TABLE IX. ACCELERATED BAYONNE ATOMOSPHERIC EXPOSURE OF PLATED PANELS
Exposure Period: 11–1–46 to 10–30–47

Panel No.	Coating Thickness, mils			Base Rusted	Pretreatment	Numerical Rating*				ASTM Rating 1 yr	Shorthand Description after 1 yr†
	Cu	Ni	Total			26 days	77	157	238		
B1	0.1	0.4	0.5	No	ASTM	2	3	3	5	0	ieZ, xRs, vmxcR
B2	0.1	0.4	0.5	Yes	ASTM	4	4	3	4	0	ieZ, xRs, vmxcR
B3	...	0.5	0.5	No	ASTM	5	5	4	3	0	ieZ, xRs, vmicR
B4	...	0.5	0.5	Yes	ASTM	3	2	2	2	0	ieZ, xRs, vmicR
B5	...	0.5	0.5	No	Anodic H_2S_4O	1	1	1	1	0	ieZ, xRs, vmscR, xpR

*Numerical rating is simply the order of merit at time indicated in days
†ieZ—intermediate amount of edge crazing
xRs—excessive amount of rust stain
xpR—excessive amount of pinhole rusting
vmscR—more than 50 crater rust spots less than 0.5 mm in diameter
vmicR—more than 50 crater rust spots 0.5–2.0 mm in diameter
vmxcR—more than 50 crater rust spots over 2.0 mm in diameter

TABLE X. HOT WATER TEST OF PLATED PANELS
Solution: Distilled water saturated with carbon dioxide
Agitation: Vigorous
Temperature: 180° F

Panel No.	Coating Thickness, mils			Rusted	Pretreatment	Number of Rust Spots				
	Cu	Ni	Total			48 hr	72 hr	96 hr	168 hr	216 hr
B1	0.1	0.4	0.5	No	ASTM	0	0	0	0	0
B2	0.1	0.4	0.5	Yes	ASTM	0	0	0	0	0
B3	...	0.5	0.5	No	ASTM	4	9	9	30	30
B4	...	0.5	0.5	Yes	ASTM	1	6	8	>150	>150
B5	...	0.5	0.5	No	Anodic H_2SO_4	0	0	0	0*	0*

*Rust spots did occur in an area on the panel that was not completely immersed.
NOTE: All panels showed an edge craze cracking.

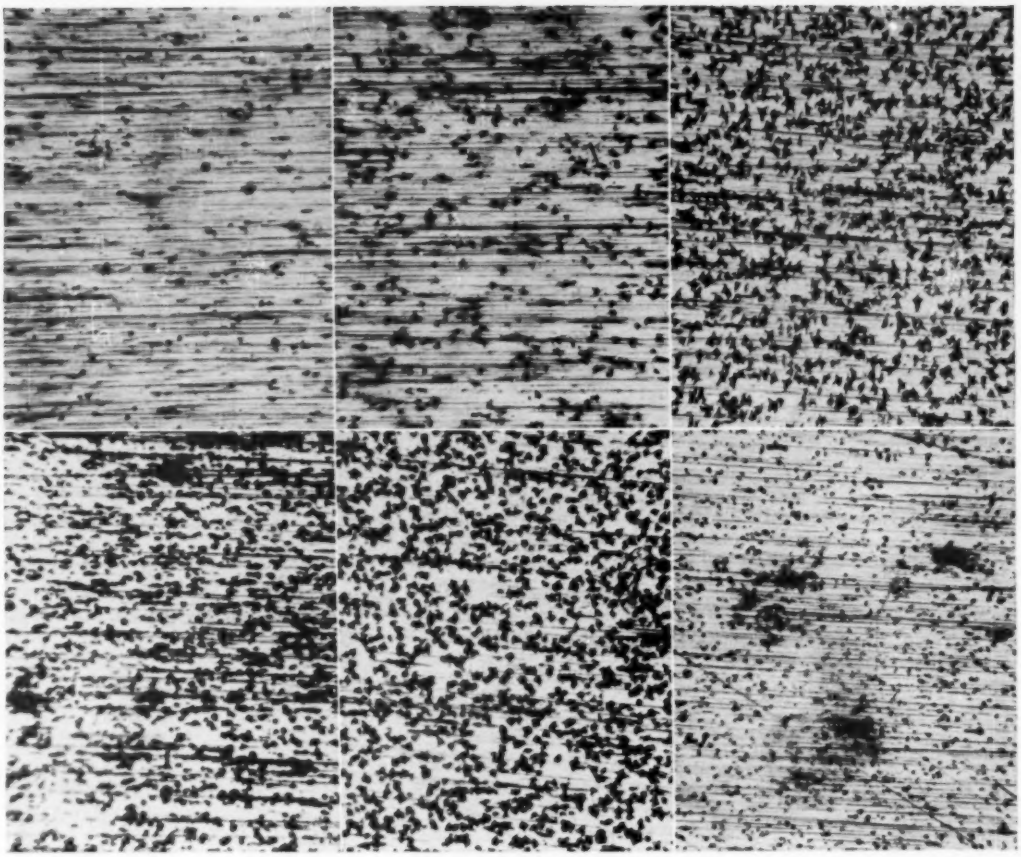

Fig. 4. Pitting in panels from Lot A after atmospheric exposure in Bayonne, N. J. 25X. From left to right, top row: 0.002-inch nickel after normal exposure for 3, 9 and 18 months (A1); bottom row: 0.002-inch nickel after 18 months' exposure to copper corrosion products (A2), 0.002-inch nickel after 18 months' exposure to iron corrosion products (A3), 0.0015-inch copper plus 0.0005-inch nickel after 18 months' normal exposure (A4)

*p*H of the water is normally between 4.5 and 5.0. This test was run for over 200 hours so that a definite difference could be distinguished between the panels. A single set of panels was exposed, and they were rated by the number of rust spots that developed on them (Table X).

Results

The Effect of a Heavy Copper Undercoat

The substitution of copper for three-fourths of the nickel in a 2-mil (51-μ) coating had a detrimental effect on the corrosion behavior of nickel-chromium plated steel panels in all exposure tests. Comparison of panels of Lots A1 and A4 in Tables V, VI, and VII and Figs. 1 and 2 show the effect of this substitution. This effect was most marked in the accelerated atmospheric exposure where the copper-nickel coated panel was completely covered with crater rust spots and rust strain. The effect was less pronounced in the salt-spray and normal atmospheric exposure, but the all-nickel coating was the more resistant to blistering and crater rusting. The effect of the copper was less noticeable after the panels had been cleaned. The ratings and description in the tables are for the cleaned panels, but the photographs in Figs. 1 and 2 were taken before cleaning.

The effect of a flash copper undercoat

Interposing a flash of copper between the steel and nickel was found to have a beneficial effect for a short time in the atmospheric exposures, but this effect was not lasting. Data in Tables VIII and IX indicate the change in the effect of the copper flash on the rating of the panels. After one year's exposure the copper appeared to have accelerated the corrosion of the iron at pores in the nickel, larger crater rust spots having formed on the panels with the copper undercoat.

In the hot-water test the flash of copper was markedly beneficial as the panels with it developed no rust

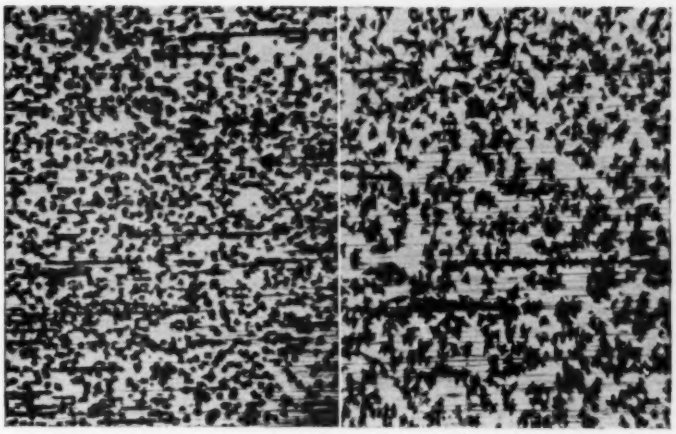

Fig. 5. Effect of intermittent spraying with common-salt solution on atmospheric test in Bayonne, N. J., of steel plated with 0.002-inch nickel plus 0.000020-inch chromium (chromium removed before photographs were taken). 25 X. Left, regular atmosphere; right, atmosphere with salt-solution-spray acceleration

spots at all. The all-nickel coating, however, showed numerous rust spots (Table X and Fig. 3).

The effect of rust on the steel base

The effect of allowing the steel base to rust before plating was determined to see if the copper flash is more beneficial on a poor surface. Comparison of panel ratings in Tables VIII and IX indicates that rusting of the steel adversely affects the protective value of the copper-nickel coatings, but it improves that of the all-nickel coating. This effect is small and did not persist in the two atmospheric exposures.

The effect of steel-pretreatment methods

The anodic sulfuric acid method was only slightly superior to the acid-dip procedure in the atmospheric tests (Tables VIII and IX). In the hot-water test, however, it was decidedly superior (Table X).

The effect of copper and iron corrosion products

Nickel-chromium plated panels of Lots A2 and A3 in Tables V, VI, and VII were exposed to the wash of copper and iron corrosion products, respectively, during their exposure. The rating and description of the panels given in the tables were made after the panels had been cleaned. Photographs of the panels before cleaning are shown in Figs. 1 and 2. The results show that both copper and iron corrosion products accelerated the deterioration of the panels. Copper appeared to have had the greater effect in the atmospheric test, and iron had the greater effect in the salt-spray test. The corrosion of the steel base through pores in the nickel was apparently accelerated by the copper corrosion products with the resultant formation of large crater rust spots. Iron corrosion products appeared to initiate the formation of rust spots, but these remained small in size.

Surface Pitting of Nickel

All panels in Lot A with the 2 mil (5μ) thick coatings exhibited pitting of the nickel in the atmospheric exposures. The attack was barely perceptible to the naked eye even after cleaning, except for a frosty appearance imparted by the very fine pits. Examination under the microscope at a magnification of 25 revealed that the pitting of the nickel coating undermined the chromium so that it was depressed in

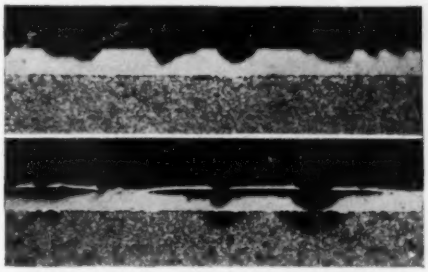

Fig. 6. Cross-sectional view of pitting attack on plated steel after 18 months' exposure to Bayonne atmosphere. 100 X. Top, 0.002-inch nickel (A1); bottom, 0.0015-inch copper plus 0.0005-inch nickel (A4)

the pits. It was the reflection from these depressed areas that produced the frosty appearance. Removal of the chromium by chemical stripping destroyed this visual effect.

Fig. 4 shows the pitted nickel surface of a group of panels at a magnification of 25. This attack was discernable after only 3 months' exposure, and the size and number of pits increased with time of exposure. On the panels from Lot A1, without a copper undercoat, the pits appear as small star-shaped holes. It is interesting to note that the iron and copper corrosion products had an effect of this pitting. Copper prevented the formation of star-shaped pits and pro-

duced pitting that was more irregular with respect to size and shape. Iron had less effect in reducing the frequency of the star-shaped form of the pits.

The pits in the panel in Lot A4 which has a composite coating of copper and nickel are not star-shaped, and the pitting appears considerably less in that the pit openings are smaller and cover less area. However, blistering, which does not show in the picture, was so extensive that the panel was given the same low rating as the panels in the other lots (Table V). The appearance of this panel before cleaning was much worse than that of Lot A1 because of the copper staining (Fig. 1).

In the accelerated atmospheric test the shape of the pits in panels from Lot A1 changed from the star-shaped form, and the area of pitting was increased, as shown in Fig. 5.

Cross-sectional views of the pits on a nickel-plated panel and the blisters on a copper-nickel plated panel are shown in Fig. 6. Pits in the nickel apparently grow in depth and breadth, but once they penetrate to a copper layer they grow more slowly in the nickel. It is evident that corrosion of the copper tends to undermine the nickel and form a blister. Likewise, when the copper layer has been penetrated, the corrosion of the steel undermines the copper layer.

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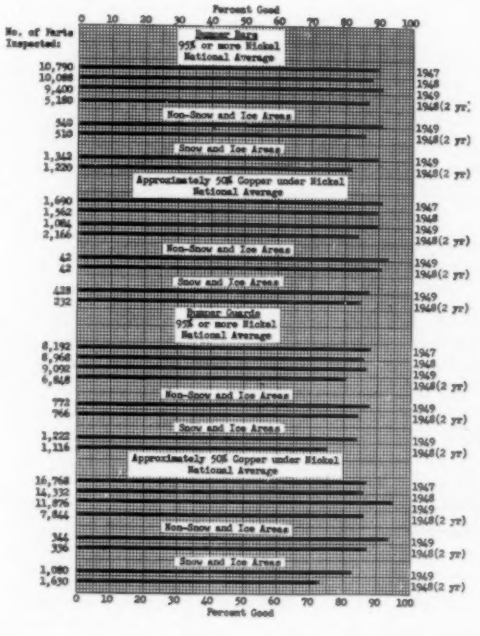
DISCUSSION

We are grateful for the opportunity to read the manuscript of the article by Knapp and Wesley and to present this discussion.

During the past three years we have each year inspected 6,000 cars manufactured during the preceding year and on each car we have rated the plate on 12 significant parts. In addition, our inspection in March, 1950 included cars that had been out since 1948. The 12 parts common to each car means an average of about 20 parts per car (e. g., there are two bumpers on a car); hence the total number of parts inspected becomes convincingly large.

The inescapable conclusion is that the nickel-chromium-plated and the copper-nickel-chromium-plated parts behaved in exactly the same way. There is no reason to prefer one to the other. Whereas no measurements were made of plate thickness, the respective parts are believed to have been plated to specifications with comparable requirements for total plate thickness.

The difference in results between the panel investigation by Knapp and Wesley and our study of automobile parts in service indicates that the panels and the parts receive very different treatments. Two notable differences are that the panels get no wiping and no oiling.—W. M. PHILLIPS, *General Motors Research Laboratories.*



THE USE OF LEAD

(*Continued from page 39*)

zinc, but it has lost popularity for several reasons:

(1) A metallic tank is likely to become a bipolar electrode, i. e., one portion becomes cathodic and gets plated, and another portion becomes anodic and corrodes in the presence of sufficient chloride. Even lead equipment outside the tank, such as a filter, may show effect of stray currents unless properly insulated.

(2) Particles of insoluble lead salts may settle on the work and cause roughness of the deposit.

(3) Contamination of the plating solution with lead may cause serious difficulty. This will invariably happen in nickel solutions containing more than 8 oz/gal of nickel chloride or equivalent, and even lower chloride contents are suspected. The corrosion protection afforded by the nickel coating is reduced; bright nickel deposits are dark in recesses; and heating may cause serious embrittlement of the plate when lead has co-deposited with the nickel.

(4) Carefully manufactured and tested rubber and plastic linings of high corrosion resistance are available which overcome all these difficulties. Nonmetallic immersion heaters or coils (of impervious graphite and even of glass) and the even more popular outside heat exchangers of corrosion-resistant materials have largely displaced the lead internal-heating coils for the same reasons. In addition, these alternate materials are suitable for a larger variety of plating solutions than lead, e. g., for fluoborate plating solutions.

Even chromium plating solutions are often kept in other than lead-lined tanks for reasons of stray currents, corrosion, and wear. Brick linings over lead-or plastic-lined tanks are common. Outside heating is becomong preferred to inside heating with lead coils.

Lead equipment should not be used with alkaline plating baths, including cyanide baths. They will dissolve lead at a rate depending on the alkalinity and temperature. Even where rapid corrosion would not result, the contamination by relatively small quantities of lead causes dull or otherwise defective deposits in all cyanide baths.

Lead anodes are standard in chromium plating baths, and very useful in sulfate solutions which require special anoding with insoluble anodes. They should have sufficient cross section to handle the required current (lead and lead alloys have low electrical conductivity) and be made of suitable alloy to reduce sagging. Where very high strength and conductivity are desired copper anodes sheathed with lead alloy are used. The effective lead peroxide film should be preserved and sulfating or chromating avoided by removing and washing the anodes when they are not to be used during any extended period of time Where this is not possible, the peroxide film may be maintained by low-current electrolysis with dummy cathodes.

NICKEL PLATING

(*Continued from page 44*)

The writer visited this plant in 1938 and was shown *Adams' original bath* which was still operating as in 1869!

Later in 1869 Mr. Adams and Mr. E. A. Quintard journeyed to England and France and set up plating plants in Birmingham and Paris. Mr. Adams says further:

"The art is today carried on substantially as it was in 1869–1870, with the same solutions, the same anodes, and the same details of shop manipulation."

This last statement was not entirely correct because the very important improvements of low-voltage generators and the addition of boric acid had been introduced long before 1905 and were then widely used.

The United Nickel Co. was formed about 1870 by Adams and some of his collaborators. This company bought or acquired Adams' principal patents and Remington's patent and during the next decade sued most of the firms doing nickel plating and collected royalties from them. The following extract from the 1879 catalogue of the Condit, Hanson and Van Winkle Company, forerunner of the Hanson-Van Winkle-Munning Company, describes the situation:

"After the decisions of Judge Blatchford in the suits of the United Nickel Co., against a number of large manufacturers in New York, in which the Nickel-Plating Patents were again sustained and subsequent injunctions granted against the Gore and other solutions, the American Manufacturers' Association, composed of some forty of the largest manufacturers in the country, decided in a body to abandon the suit and take out licenses; their action has been followed by many others throughout the country, the licenses now numbering about three hundred. The result has been so far, in many cases, to advance the price of nickel plated goods, notably saddlery hardware, stoves, etc. As both cast and grain nickel anodes were covered by patents, the Cast Anode Patent having been twice decided in favor of the United Nickel Co., we decided, after a six years' contest against this patent, to settle with the United Nickel Co., and depending on the increased sale for our profits, rather than on an advance in price, to meet the royalty exacted, and in all cases guaranteeing the quality".

(*To be continued*)

For the first time an A. E. S. Convention was attended by a Delegate from one of the three Australian Branches; Mr. J. J. Dale was present at the recent Convention at Boston as a Delegate from the Melbourne Branch. After the Convention he spent two months visiting the chief plating centers in America, gathering information on behalf of both the Australian Government and the Australian plating industry, joint sponsors of the trip. In this article he gives an account of the tour and lists some of his main impressions of plating in U. S. A.

AN AUSTRALIAN LOOKS AT U.S. PLATING

By J. J. DALE

Defence Research Laboratories, Maribyrnong, Victoria, Australia

Secretary, Melbourne (Australia) Branch, American Electroplaters' Society

It was a cool winter's day in Sydney as I boarded a DC-6 to take off on the first hop of the journey to Boston via San Francisco and New York. Modern travel arrangements on this route are so good that even a person with no experience of air travel can really relax and enjoy the trip. The first evening found us in the tropical hear of Fiji for dinner. We then climbed into a comfortable bunk for the overnight flight to Canton Island. From there it was a daylight hop to Honolulu, where an eight-hour stop allows for a very pleasant introduction to the American way of life. Then more sleep while the plane droned through the night to the mainland. After a few hours to relax and see San Francisco, I boarded the "Streamliner" for Chicago *via* Ogden and Cheyenne. Thence immediately to New York in time to spend 3–4 days "arranging" before going on to Boston.

The first call made was to 473 York Road, Jenkintown, Pa., to check with Dr. Graham and Gus Soderberg. To the latter goes much of the credit for the success of my trip, the route followed being almost exactly the one he had suggested by letter before I left Australia. On this occasion he reinforced his earlier suggestion with lists of firms to be visited in various cities (to be backed up later with many introductions at the Convention). Another call was to the New York offices of Metal Finishing. Boston was reached on the Sunday, by means of a pleasant drive with the four hearty occupants of these offices.

A Convention is obviously quite an event even to American A. E. S. members, and its affects on a foreigner may be imagined. Technical sessions of great interest were nicely blended with enjoyable social engagements, and a general air of good fellowship was present on all occasions. To me, personally, the most valuable aspect of the Convention was the opportunity of meeting so many fellow platers, including the majority of the "big names" in the industry, names which so many of us in Australia have only been able to read about for many years. Truly, it was a thrill to meet them in the flesh and to find them willing to spend time talking to one who could offer them little, but who was clearly out for all he could get. Many appointments for later plant visits were made in this crowded and hectic week.

From Mr. Dale's first lecture about American plating practice, held on September 21 in Melbourne Public Library and reviewed in the Melbourne Branch News in the November issue

The week following the Convention was spent in Connecticut, using Hartford as a base. From there, under the benevolent overlordship of Art Logozzo, I made day trips to see plants in Hartford and in nearby towns. (When I heard Art described as a "tank man" I thought reference was being made to his way of plowing through obstacles, but I find it merely means he has worked over a plating tank). Among plants visited were those of Electrolux at Old Greenwich and Chromium Corporation of America at

Waterbury, where Messrs. Hodges and Sternfels respectively showed me the works. In Hartford itself I spent a wonderful day at the Pratt & Whitney plant (with a helicopter ride thrown in) and another day visiting the Royal and the Underwood typewriter plants. (A vacuum cleaner has somewhat fewer parts to plate than a typewriter). The name of Dr. "Hank" Hellner must also be mentioned here as a friend, philosopher and guide during my time in Connecticut.

The next week I used New York as a base for operations both in the city itself and in New Jersey. I had a valuable series of interviews with corrosion experts Sample, Wesley, Copson, and Mendizza. Other highlights of this week were visits to the Hanson-Van Winkle-Munning laboratories at Matawan, N. J., Federal Telephone & Radio Corporation's plant and laboratories at Knutley, N. J., Curtis Wright plants at Woodridge and Caldwell, N. J., and to the R. C. A. record plant in New York. The week after this contained July 4 and included little apart from supply-house gossip and defense-plant visits in Philadelphia. In Baltimore an interesting half day I spent at the piston-ring plant of the Koppers Company discussing my favorite topic, chromium, with R. D. Guerke.

On arriving in Washington I was warmly greeted by Dr. Blum, who filled my book with visits for the week and spent the rest of the morning showing me over the Bureau. The afternoon was very profitably spent in long and earnest discussions with Dr. Brenner and his staff. The Bureau of Engraving and Printing and the Government Printing Office I found to be places which must not be missed by plating-minded visitors. Then a lengthy but pleasant rail trip took me to Pittsburgh, Pa., from where Sam Johnston whisked me over to see his fabulous continuous tin plating line at Wierton, W. Va. His total-available-amperage figure of a half million amperes would, I knew, evoke a few gasps back home. The colour of his solution also seemed to illustrate what could be got away with if cathode movement were really fast. Also, while in the district, I had a most stimulating interview with George Jernstedt and obtained "from the horse's mouth" the latest information on PR plating.

Next move was to Columbus, Ohio, to see the Battelle Memorial Institute. Here Dr. Charles Faust gave up most of a day to show me various ingenious experimental set-ups and to discuss many aspects of plating. I just missed meeting A. E. S. President Neill on his home ground before I left on a quick trip to Middletown, Ohio, to discuss atmospheric corrosion testing at Armco. In Cleveland I was shown the wondrous bearing plating being done under the guidance of Dr. Ralph Schaeffer at Cleveland Graphite Bronze Company. Also in this town, acquaintance was renewed with Art Du Rose of Harshaw. Then, on to Detroit.

Here, strange to relate, the talk always seemed to have some connection with automobiles. If I started telling details of plating sights in Detroit I would be a long time finishing. However, I did see more gallons, amperes and parts in a week than I will see again in many a year. For a fine time in Detroit my thanks go to Pinner, Saltonstall, Clifton and Phillips.

From Detroit the trail led to Chicago, where I visited some "small" establishments. Another convention-made date was kept with a call on Joe Andrus at Croname, Inc. A fitting technical climax to the tour came on my trip up to Milwaukee to see Phil Ritzenthaler's Plating Engineering Company and to spend a very profitable hour or so discussing with him two of my pet subjects, heavy-nickel plating and electropolishing.

Within two months some 50 establishments were visited and a large number of plating men interviewed (there are 150 names and addresses in my notebook). Thanks to the extreme helpfulness and generosity of everyone I obtained a mass of information (occupying 60 pages of typed notes) which should be of considerable assistance to Australian platers. Included are details of new processes, better ways of doing old things, hints on cleaning, rinsing, testing of deposits, and control of solutions. I have many ideas on laboratory equipment, and methods and notes on researches both in progress and projected. Of value at least equal to this written information is a feeling of personal friendship with many of the most competent platers in the country, to whom I can write when help is needed. Furthermore, one's interest in reading U. S. plating literature is greatly helped by having met many of the authors and seen many of the places described.

My impressions of the tour are so many and varied that it is quite difficult to begin to set them down. Actually, a number of impressions have already appeared in the foregoing account of the trip. For the rest one cannot help being impressed with the almost universal use of automatic plating machines and bright-nickel plating processes in the larger plants and with the enormous quantities of work being handled. Control of these large baths is excellent—probably because fifty thousand gallons must not go wrong.

There seems to be several well equipped laboratories devoted to plating research, some with quite large staffs. It was noticeable that by far the most emphasis was on "practical" research. There seems to be a point to Dr. Wesley's Convention observation that the industry can not keep on advancing on practical research alone. I doubt if other branches of science would permit challenges, such as are presented by the lack of good explanations for bright plating, to go unanswered for so long without some reasonable theories being put forward.

Practical research being done is of very high quality and has gone a considerable part of the way towards eliminating lathe buffing and polishing. This success has come from combining methods of cheaply obtaining a relatively smooth finish before plating with one or more of the processes giving leveling, i. e., electropolishing, PR plating, and use of plating solutions with leveling properties. The other field of research notable for recent advances is alloy plating, although in this there are surely many discoveries yet to be made.

That the plating industry has won itself a respected position among other industries is exemplified by the outlay on this department in the big factories and the way metal suppliers are now willing to supply raw materials to suit platers' needs. The plating-supply houses seem to be doing a fine job. I was struck with the candor with which some representatives described their own and other people's products, and it was strange to find some platers with higher opinions of a salesman's products than the salesman had himself.

As to my impressions on things not having to do with plating, these would fill another article equally long. Suffice it that I was impressed, as must be every foreigner, with the size, standard and convenience of both travel and accommodation arrangements throughout the country. (It did seem, on occasions, that a thing must be almost impossibly good before an American is satisfied with it.) In general, the United States impressed me as a very fine country that is really going somewhere. The easy general pattern of life and the extreme hospitality of the people cannot help but leave one with the warmest feeling towards the whole country and everyone in it. In particular the electroplaters I met were extremely kind and thoughtful and did everything they could to help me. To them, and to the Australian platers who helped to have me sent away, I wish again to record my thanks.

project no. 12

project director:
HENRY B. LINFORD*

associates:
EDWARD B. SAUBESTRE*

location:
COLUMBIA
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Cleaning and Preparation of Metals for Electroplating

I. CRITICAL REVIEW OF THE LITERATURE

(*Continued from the December 1950 issue*)

Table IV gives the *p*H values of various alkaline compounds at a concentration of 1 per cent (by weight). The values given are taken from a graph of *p*H as a function of concentration[32]. Except for the various sodium carbonates and sodium tetraphosphate, the *p*H generally rises linearly with the logarithm of the concentration.

Most cleaning solutions are spent to some degree in the course of use, even aside from saponification reactions. Their alkalinity may be reduced by reaction with acidic solutions, by combination with hard-water salts, or by adsorption on solid dirt or emulsified oils[112]. Buffered cleaning solutions are of value in giving continually uniform results. Three kinds of buffer action are of interest in metal cleaning[113]: (a) Concentration action, where *p*H is maintained as a result of the relatively large amount of the material present; as the substance is used up, its total concentration decreases, but with this decreasing concentration is associated an increasing proportion of the material in the active state. (b) Buffering due to hydrolysis of salts of weak acids and strong bases; as base is used up, more salt hydrolyzes to maintain the *p*H. (c) Buffering occurring when very strong electrolytes are combined with weaker electrolytes of low activity. When the salts have an ion in common, the stronger electrolyte will depress ionization of the weaker one. As the strong electrolyte is consumed, its concentration will decrease and its depressing effect on the ionization of the weaker electrolyte will be reduced, with a net increase in ionization of the weaker electrolyte, thus helping to maintain *p*H. Buffer value may be determined as follows[101]:

$$\beta = \frac{\Delta B}{\Delta pH}$$

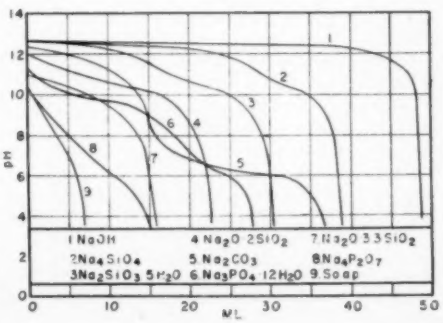

Fig. 1. Buffer curves for 1 per cent solutions of cleaner chemicals

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where β is buffer value, ΔB is the number of gram equivalents of reagent added per liter, and ΔpH is the change in pH of the solution.

Fig.1 shows titration curves for 1 per cent solutions of cleaner chemicals. Caustic soda is seen to be a good buffer only at pH higher than 12, which severely limits its use as a buffer in metal cleaning. Silicates are generally good buffering agents at a pH exceeding 9, and phosphates are good buffers in the pH range 8–11. Soda ash has good buffer action, but at a pH range too low to be of interest in metal cleaning.

In comparing various alkalis with one another, one should not forget that total available alkalinity is unimportant—what must be considered is the total active alkalinity, i. e., the amount of alkalinity available at a pH higher than 8. One quick way of obtaining this information is to titrate to the phenolphthalein end point (pH 8.3) for total active alkalinity and the methyl orange end point (pH 4.5) for total available alkalinity. Table V was derived from data in the literature[22] and from Fig. 1. Notice that nearly all the silicate alkalinity is active, while phosphates, borates and soda ash have considerable alkalinity of little value to metal cleaners.

b. *Surface action.*—The most important factor in detergency is low interfacial tension between the cleaning solution and the metal being cleaned. This low interfacial tension enables the cleaning solution to undermine the soil, breaking it up into detached globules. Saponification plays some part but is not as important as the ability to displace and emulsify soil. Table VI indicates which films are water wettable and which are not. Surface-active materials are added to cleaning solutions to lower surface tension and because of their solvent action. This leads to greater detergency, for every good detergent solution has low surface tension against air and low interfacial tension against metal.

Surface layer[101]: The interface separating a pure liquid and its vapor is ordinarily conceived as a mathematical surface, with sharp abrupt changes in physical properties across it. The optical properties of a liquid surface indicate that the transition is very sharp, taking place predominantly in a layer approximately one molecule in thickness. On account of this extreme density gradient it is not surprising to find that the interface exhibits certain peculiar properties, of which the phenomenon of surface tension is perhaps of greatest importance in this study.

Contact angle and surface tension[101]: If a flat glass plate AB (a metal surface would behave in the same manner) is immersed in a liquid, as in Fig. 2a, there will be two main forces acting on liquid molecule C. The forces of mutual intermolecular attraction between the liquid molecules tend to drag the molecule in

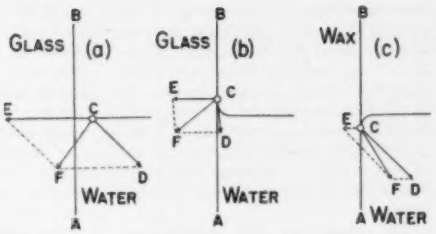


Fig. 2. Forces which determine contact angle between a liquid surface and a solid.

question down into the liquid, but at the same time it is drawn towards the glass by the attraction upon it of the field of force of the latter. In Fig. 2, CD is equal to force of cohesion and CE is equal to force of adhesion. The resultant is CF, and the surface of the liquid will tend to set itself at right angles to it. Thus C moves up the plate. As this occurs, the forces acting on C due to cohesion will become more nearly vertical but far smaller in magnitude, and the resultant becomes more nearly perpendicular to the glass. Hence the meniscus shown in Fig. 2b arises. The angle which the water surface makes with the solid at the ultimate point of contact is known as the contact angle. If the molecules of the liquid have little affinity for the solid, e. g., water for paraffin wax, the cohesive force is so much greater than the adhesive force that the resultant CF, in Fig. 2c, is directed downwards into the liquid.

Low surface tension is essential not only to wetting but also to emulsification and penetration. Mere formation of a solution does not decrease surface tension. For example, adding salt or caustic soda to water increases the surface tension. Colloidal materials, on the other hand, may drastically lower surface tension[123]. When the surface tension of a pure liquid is lowered by addition of a second substance such as soap, its concentration in the surface of the liquid is higher than in the body of the liquid.

Emulsification and deflocculation[101]: An emulsion is a two-phase system consisting of fine droplets of one liquid dispersed in a second liquid with which it is incompletely miscible. If the droplets be large, they will rise or fall due to density differences, and the liquids tend to separate into layers. If the droplets be small, they will be agitated by Brownian movement, which will ultimately bring them into contact by collision. In either case, when the particles touch, interfacial tension tends to cause coalescence. The most important means for preventing contacts

TABLE V. RELATIVE ALKALINITY OF VARIOUS COMPOUNDS

Base	Active Na_2O %	Total Na_2O %	Equivalent Cleaner* g
$NaOH$	75.5	77.5	1.0
$3Na_2O.2SiO_2.11H_2O$	23.8	24.7	3.2
$Na_2SiO_3.5H_2O$	28.0	29.2	2.7
$Na_2O.1.6SiO_2.8.8H_2O$	18.7	19.7	4.0
Na_4SiO_4	65.8	67.5	1.1
$Na_2O.2SiO_2$	31.9	34.0	2.4
$Na_2O.3.3SiO_2$	21.3	23.8	3.5
$Na_3PO_4.10H_2O$	10.0	18.0†	7.6
$Na_4P_2O_7$	8.1	23.3‡	9.3
Na_2CO_3	29.0	58.0	2.6
$Na_2B_4O_7.10H_2O$	8.4	16.3	9.0

*This column gives the number of grams of alkaline compound required to give the same amount of active Na_2O as one gram of sodium hydroxide.
†to NaH_2PO_4
‡to $Na_2H_2P_2O_7$

TABLE VI. CHARACTERISTICS OF METAL SURFACE FILMS[118]

Water Repellent Films	Water Wettable Films
Mineral oil and fats; animal oil and fats; vegetable oil and fats	Scale
Soaps and soap substances	Heavy oxide coatings
Fatty acids (present in free state)	Passive surfaces
Dust, and carbon smut	Films of metal silicates, phosphates and chromates
Gas adsorbed on the metal surface	

between particles are: (1) a charge on the particles (hydrosols) and (2) the presence of a film about the particle which is protective and resistant but not adhesive. To prevent coalescence, the film must be in the dispersing liquid around the droplet rather than in the droplet itself. Films of such characteristics arise from the use of such highly solvated emulsoidal materials as gelatin, soap, casein, and synthetic detergents.

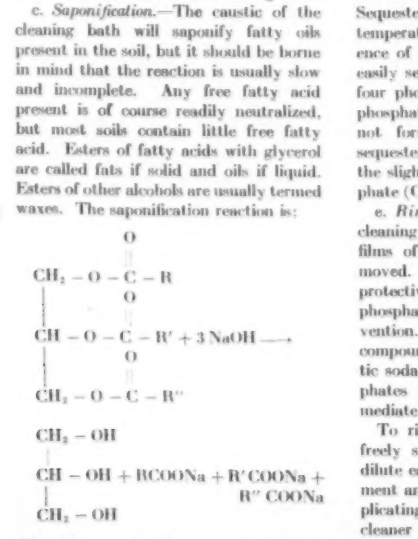
The emulsifying and deflocculating abilities of detergents are functions of concentration, *p*H, and temperature.

Concentration: When dispersive (suspending) ability is plotted against concentration of detergent, sharp maxima occur[110]. The cause of these maxima is not well understood but is probably related to the influence of concentration on the molecular structure of soap in solution. Optimal solution concentrations are in the range of 0.01–1 per cent (by weight) Na_2O content.

*p*H: Soaps are generally most effective in the *p*H range of 9–11.

Temperature: Most soaps are the more effective at low temperature. This is probably because soap solutions, colloidal at room temperature, convert to true solutions at higher temperatures. The size of the colloidal particles is a function of the fatty acid used, the alkali combined with it, the *p*H, and the temperature[123]. Furthermore, the concentration of electrolytes affects the state of a soap colloid. Small amounts of added caustic increase the detergent action of soaps up to a limiting value by influencing the equilibrium between dissolved and colloidal soap to bring into action a larger proportion of the more active colloidal form. Continued addition ultimately reverses this effect[123] due to "salting out".

c. *Saponification.*—The caustic of the cleaning bath will saponify fatty oils present in the soil, but it should be borne in mind that the reaction is usually slow and incomplete. Any free fatty acid present is of course readily neutralized, but most soils contain little free fatty acid. Esters of fatty acids with glycerol are called fats if solid and oils if liquid. Esters of other alcohols are usually termed waxes. The saponification reaction is:



The R's may be the same, but this is rarely the case. Information on the fatty-acid components of several oils may be found in texts on organic chemistry. Naturally, the soaps formed by saponification in the cleaning bath add to its cleaning ability, as discussed previously under surface action.

d. *Water hardness.*—Calcium and magnesium bicarbonates are precipitated in alkaline solutions as carbonates, causing hard scale to form[109]. Ortho-phosphates in the cleaning bath may precipitate as an adherent scale along with excess carbonate[109]. Silicates in the cleaning bath occasionally form hard scales, sometimes impregnated with silica, but more often they form an easily rinsed sludge of colloidal nature consisting of calcium and magnesium meta-silicates[109]. When soap is present, the calcium and magnesium compounds formed are insoluble leaving films on the metal when rinsed in hard water[108]. When the work is subsequently acid dipped, the free fatty acids are regenerated and the metal has become soiled again.

Where the water has not been previously softened by zeolite treatments or the like, the problem of water hardness may be solved by the addition of sequestering agents to the bath[4,109,112]. Examples of such agents are:

Sodium hexametaphosphate, $Na_6P_6O_{18}$
Tetrasodium pyrophosphate, $Na_4P_2O_7$
Sodium tetraphosphate, $Na_6P_4O_{13}$
Sodium polyphosphates,
$Na_5P_3O_{10}.6H_2O$ (among others)

The action of these agents is not fully understood, but it is associated with the formation of soluble calcium and magnesium ion complexes, for example[102,112]:

$$2\ Ca^{+2} + Na_6P_6O_{18} \rightarrow$$
$$4\ Na^{+} + [2\ Na^{+} + (Ca_2P_6O_{18})^{-2}]$$

Sequestering ability is reduced at high temperature and is affected by the presence of other ions. Magnesium is more easily sequestered than calcium. Of the four phosphate types cited above, pyrophosphate is the least effective. It does not form soluble complexes, and its sequestering ability probably arises from the slight solubility of calcium pyrophosphate ($Ca_2P_2O_7$).

e. *Rinsability.*—Objects leaving the cleaning bath should be rinsed until all films of cleaning agents have been removed. Exceptions to this arise where protective coatings, e. g., of silicate or phosphate, are desired for corrosion prevention. Among the common alkaline compounds used in metal cleaning, caustic soda has the lowest rinsability, phosphates the highest; silicates are intermediate.

To rinse well a substance should be freely soluble in water so that it will dilute easily. Caustic meets this requirement and yet is a poor rinser. The complicating factor here is adsorption of the cleaner onto the metallic surface, caustic being readily adsorbed on glass and metal surfaces. Breaking of emulsions must also be considered as a factor in rinsing. Oil and fats are present on the metal surface as emulsions dispersed in water. If these emulsions are broken during rinsing, reprecipitation of the nonaqueous phase will occur on the work. There are two main causes for breaking of emulsions during rinsing: (a) the emulsifying agent is not effective at the low concentrations and (b) the rinsing water is such that it destroys the emulsifying properties of the emulsifying agent, e. g., some hard water and acidic waters[103].

f. *Corrosion.*—With iron and steel, there is no serious corrosion problem in the use of the usual alkaline cleaners. However, with other metals, such as copper and its alloys, tin, zinc, and aluminum, corrosion of the metal becomes a problem[8]. Silicates are the best corrosion inhibitors for these metals when used with other alkalis, except with soda ash for zinc and its alloys. Among the silicates, those with high SiO_2/Na_2O ratios are the best in this respect[8,32,70], but unfortunately they form heavy films, which are difficult to remove by rinsing, the corrosion inhibition being due to a protective, adherent silicate film. Silicates of low SiO_2/Na_2O ratio (<2) slightly increase corrosion by caustic. This is not the case with highly siliceous silicates[150]. Conversely, all silicates in all ratios decrease soda ash and phosphate corrosion very markedly[32].

The order in which 0.1–1 per cent (by weight) alkaline cleaning solutions corrode aluminum is: $NaOH > Na_3PO_4 > Na_2CO_3 >$ silicates[92,142]. In general, silicates should constitute at least 10–12 per cent (by weight) of the cleaning composition to be effective as aluminum corrosion inhibitors[150].

In uninhibited solutions, the *p*H should not exceed the following values for the metals indicated[156]:

Zinc	Aluminum	Tin	Brass	Duriron
10	10	11	12.5	13

g. *Electrolytic effects.*—The most important difference between nonelectrolytic and electrolytic alkaline cleaning lies in the mechanical effect of the gases liberated at the electrodes. Hydrogen arises at the cathode and oxygen at the anode. Since the gases are liberated either at or extremely close to the true metallic surface, soil adhering to the metal is easily detached and broken up. Thus, gas evolution in electrolytic cleaning provides for penetration of soil, aids in emulsification, and takes care of agitation requirements. This mechanical action is probably as important as any other in the bath. It might be thought, therefore, that the more gas is evolved, the better would be the cleaning, and that current density should be raised indefinitely. There are, however, certain limitations. Aside from the chemical action of the gases evolved, to be discussed below, too high a current

TABLE VII. PROPERTIES OF SOLVENTS

Common Name	Formula	Density of Liquid* g/ml	Specific Gravity of Vapor air = 1	Boiling Point ° C	Solubility in Water* g/100 ml	Flash Point ° C	Specific Heat (20° C) cal/g. ° C	Latent Heat cal/g
Benzene	C_6H_6	0.879[20]	2.77	80.1	0.082[22]	−27 to +10	0.41	94.3
Toluene	$C_6H_5CH_3$	0.866[20]	3.14	110.8	0.047[16]	6 to 13	0.42	86.5
Benzine	.....	.....	4.48	.....	.....	−20 to −12	.....	.....
Tetrachlorethane	$C_2H_2Cl_4$	1.59[20]	5.8	130–146	i†	none	0.268	55.1
Pentachlorethane	C_2HCl_5	1.67[25]	7.0	162	i	none	.....	.....
Hexachlorethane	C_2Cl_6	2.09[20]	8.2	subl. 187	i	none	.....	.....
Methylene chloride	CH_2Cl_2	1.34[20]	2.9	40.1	2[20]	none	0.288	78.6
Chloroform	$CHCl_3$	1.50[15]	4.1	61.3	1[15]	none	0.234	59.0
Carbon tetrachloride	CCl_4	1.60[20]	5.3	76–77	0.08[20]	none	0.201	46.4
Dichlorethylene	$C_2H_2Cl_2$	1.27[15]	3.4	48–61	i	49	.....	.....
Trichlorethylene	C_2HCl_3	1.46[25]	4.6	87	0.01[20]	none	0.223	57.3
Tetrachlorethylene	C_2Cl_4	1.63[15]	5.7	121.2	i	none	0.211	50.1

*At indicated temperature, ° C. †Insoluble.

density results in a blanketing of the electrode surface with gas, which, among other things, increases cell voltage.

In addition to mechanical effects, the gases evolved at the electrodes may react chemically with the metal surface or with the soil. At the cathode, hydrogen reduces oxides present on metal surfaces, and undesirable metal films may be electrodeposited from impurities in the cleaning bath. At the anode, oxygen attacks many metals, causing tarnish, passivation, etc., and the oxidation helps break down dirt, rendering it more easily removable.

With regard to physical action, evolved gases may diffuse into the metal, causing such effects as hydrogen embrittlement.

B. Solvent Cleaners

As this method will not produce the chemically clean surfaces required for plating[89,48], it will not be discussed here at great length. In industry, solvent degreasers often appear at the head of the cleaning cycle for removal of the bulk of the oil. Best results are obtained where about 90 per cent of the grease is removed by a solvent degreaser, leaving 10 per cent on the work as it is sent to the nonelectrolytic or electrolytic alkaline cleaner[48,151]. The solvents will remove fats and oils, pitch, resins, wax, paraffin, etc. The ideal grease solvent should meet the following requirements[109]:

1. Degrease when cold or hot, or in vapor state
2. Nonflammable
3. Inert to metals
4. Stable
5. Nontoxic
6. Boiling point under 100° C (212° F)
7. Low specific heat and latent heat
8. Vapors heavier than air
9. Liquid phase of high specific gravity and low surface tension

The properties of some common grease solvents are listed in Table VII.

The earliest solvents were benzene, toluene, benzine, and the like, but owing to their inflammability, they have today been replaced by the chlorinated hydrocarbons. The compounds commonly used today are tri- and tetrachlorethylene[115]. The work may be dipped in the hot liquid solvent. On removal, any adhering liquid vaporizes, leaving the work hot and dry[115]. Another method is to place the cold object in a vapor chamber. The vapor condenses upon striking the cold object, and the liquid thus formed dissolves grease. If the liquid drains freely, the solvent-oil mixture will run off the work as rapidly as it is formed. The oil, because of its high boiling point, will not be revaporized from the heated sump below, and the vapor, and consequently the liquid condensing on the surface of the work, wil always be nearly pure solvent. Obviously, the work will be warming up during this process, and eventually the condensation will cease and the process stop. Thus, a heavy object will be almost completely cleaned of a comparatively heavy film of oil, whereas a thin sheet will not be cleaned of even a light oil film by such a process[115]. It should be remembered, however, that solution of oil raises the boiling point of the solvent. Hence, if the vapor is not super-heated excessively, this limitation can be overcome to some extent[152].

In addition to vapor losses in the equipment, drag-out losses by trapping and capillary attraction are major sources of solvent loss on articles other than flat sheets.

Tri- and tetrachlorethylene are unstable in the presence of strong light, high temperature, acid, and some trivalent metallic chlorides. In recent years, many types of stabilizing inhibitors have been developed[41,42,94,139,141].

The toxicity hazards of tri- and tetrachlorethylene are relatively great, and much care must be taken in designing equipment for such processes[27,74,127,150,152,156,145,158,188].

C. Solvent-Emulsion Cleaners

In the 1920's it was discovered that emulsifiers could be added to solvents of the type discussed above. Stable emulsions were used, applied by either of two methods[4,46,93,148]:

a. The soiled work is dipped into a solution of solvent and soap (potassium resinate or oleate) or other emulsifying agent. The hydrocarbon solvent dilutes the oil and spreads the emulsifying agent over the surface of the soil particle. The work is then rinsed with a water spray to remove most of the contaminants. The solvent adhering to the surface is largely emulsified and washed away.

b. The metal is soaked in or sprayed with stable emulsions, such as a 1–10 per cent mixture of kerosene or similar hydrocarbon fraction in water, stabilized by soap, sometimes with excess alkali. This is followed by a water rinse.

In both methods, it will be noticed that only one phase is present, except for a brief moment during the water rinse. Far more effective in removing soils are solvent-emulsion cleaners applied as diphase cleaners. This involves simultaneous contacting of the surface with (1) a solvent which preferentially wets the metal and (2) water, the water being present in much larger proportion and the contacting lasting a controlled length of time. Although some of the solvent may be emulsified in the water, this is incidental and is usually avoided if possible. Such cleaners may be applied in two ways[20,0,93,109,149].

a. For dip cleaning, the bath consists of a layer of unemulsified solvent on top of an aqueous emulsified layer.

b. For spray cleaning, a mechanical mixture of an unstable emulsion of water, emulsifier, and excess solvent is used.

Snell and his co-workers have presented

some interesting papers on di-phase cleaners[105], and much of the following discussion has been drawn from this source. Characteristics of di-phase cleaners are[105]:

1. The metal is subjected to simultaneous action of an aqueous phase and a solvent phase. Neither phase is completely emulsified in the other.

2. The solvent phase is capable of dissolving oils and preferentially wetting metal surfaces.

3. The aqueous phase dissolves water-soluble soils and preferentially wets various mineral soils.

4. The solvent phase is of low viscosity.

5. The solvent phase shows some tendency to emulsify either in water or in suitable aqueous solutions which may be used for rinsing.

Di-phase cleaners show much greater tendency to deflocculate and suspend soils than do stable emulsions. The low dispersing power of stable emulsions is attributed to the soap being substantially tied up at the surface of the emulsion droplets. The fatty acids released by hydrolysis go into the oil droplets, and thus the concentration of soap available in the aqueous solution is very low. With di-phase cleaners, very little solvent is emulsified, and substantial quantities of soap remain in the aqueous phase.

Solvent-emulsion cleaning is particularly useful for removing solid dust and dirt mixed with oil, such as pigmented drawing compounds and buffing compounds[4,46,53], and is valuable for removing heavy oil films from objects which are deeply creviced, etc. However, it leaves behind an oil film, so that an alkaline or electrocleaning treatment is necessary prior to plating. The preliminary solvent-emulsion treatment, however, greatly decreases the load in the final cleaning bath.

D. Alkaline Copper Cyanide Cleaners

Alkaline copper cyanide cleaners have, in the past, found much application in electroplating practice. In recent years, however, with the advent of anodic alkaline cleaners, the cyanide cleaners have virtually disappeared from the industrial scene in the United States.

The alkaline copper cyanide cleaners first came into use when it was noted that metals which would not deposit well over a basis metal could be made to do so if the basis metal first received a thin copper plate in a cyanide bath[109]. In such cases, it has been thought advantageous simultaneously to clean the work and plate it with copper by the use of an electrolytic alkaline copper cyanide bath. The alkali degreases the metal, and copper plates onto the metal as clean metal surface becomes exposed. Vigorous gassing occurs on remaining soiled areas until the entire surface is cleaned and copper plated[108], because the hydrogen overvoltage on copper is higher than that on iron. Oxides of zinc, copper, tin and lead, which have not been subjected to high temperatures, dissolve readily in alkaline cyanide baths[39].

An example[36] of such a bath is: CuCN—3 oz/gal (22 g/l); NaCN—4 oz/gal (30 g/l); Na_2CO_3—1½ oz/gal (11 g/l); 3–4 asf (0.3–0.4 amp/dm²).

Bath composition must be carefully controlled. Excess cyanide lowers efficiency, leading to excessive evolution of hydrogen at the cathode[36]. A deficiency of soda ash and sodium cyanide causes copper plating on greasy spots[37,108] and is conducive to the presence of the relatively insoluble CuCN and CuOH at the anode[37,38]. It is often customary to preclean in solvent or solvent-emulsion baths, otherwise the time of contact in the cyanide bath is too long, and the quality of the copper deposit is lowered.

It should not be thought that the appearance of copper layer is indicative of the success of the degreasing. There is a tendency in cyanide baths for the metal to plate under the soil, and at times it may bridge over dirt particles.

E. Descalers

Before plating, enameling, etc., oxides and other miscellaneous soils resulting from previous heat treatment, rusting in air, action of alkaline cleaners, etc., must be removed.

1. *Abrasion cleaners*

Where heavy deposits of rust and scale must be removed, abrasion cleaners are common. These cleaners also serve to remove burrs, unwanted sharp edges, etc. Abrasion cleaners customarily precede any other cleaning treatments other than heavy prepickling and include grinding, scraping, sandblasting, buffing, and polishing. These methods usually require much hand labor and are wasteful of metal.

2. *Acid pickling baths*

When iron is heat treated at 575° C (1067° F) or higher temperatures, oxides form in the following well defined layers. The bottom layer is a solution of oxygen in FeO (Fe:O = 1:1.09), with finely divided crystals of Fe_3O_4. Next comes a layer of Fe_3O_4 and finally an outer layer of Fe_2O_3[109]. On cooling below 575° C (1067° F), the FeO phase decomposes into Fe_3O_4 and very finely divided iron. It is only this layer which dissolves easily in acid. There appear to be three spontaneous reactions involving the hydrogen ion from the acid, all of which proceed by electrochemical mechanisms[94]:

$$Fe + Fe_3O_4 + 8H^+ \rightleftharpoons 4Fe^{+2} + 4\,H_2O$$
$$E^\circ = 1.42 \text{ volt}$$
$$Fe + Fe_2O_3 + 6H^+ \rightleftharpoons 3Fe^{+2} + 3\,H_2O$$
$$E^\circ = 1.18 \text{ volt}$$
$$Fe + 2H^+ \rightleftharpoons Fe^{+2} + H_2 \quad E^\circ = 0.44 \text{ volt}$$

As long as scale is close to the basis metal, the first two reactions predominate. They are more spontaneous, and polarization effects at the cathode are less than for the third reaction. Only when appreciable areas of basis metal have been exposed does hydrogen evolution begin[39].

Hydrochloric and sulfuric acid attack the steel surfaces. Inhibitors of various types are used at times to minimize this action by adsorption on the metal surface. Pickling may leave residues of acid, ferrous salts, and inhibitors. Thus, thorough rinsing in water is necessary before plating.

Copper and its alloys may also be pickled in sulfuric or hydrochloric acid solutions, but these metals may require a final sodium cyanide dip to dissolve tarnish. Aluminum is usually treated with a phosphoric acid solution.

Electrolytic pickling is also used[14,114]. The bath compositions are similar to those in nonelectrolytic pickling, but the time of contact is usually shorter. Both methods consume about the same amount of acid, but electrolytic pickling has the advantage of permitting the use of lower temperatures and may produce a better surface for subsequent plating. The work is usually made the cathode to help prevent acid attack of the metal. The hydrogen evolved assists in breaking up scale on the surface. When lead anodes are used, chlorides should not be present in the bath, lest lead be deposited on the work. Hydrochloric acid pickling solutions could therefore not be used under such circumstances. On the other hand, some electrolytic pickling processes are deliberately designed to plate metals onto the work. In the Bullard-Dunn process[20] a tin or lead coating is applied to the metal as it is being cleaned. A typical solution is: 2.2 parts lead or tin salt, 11 parts 66° Bé sulfuric acid, 3.5 parts 20° Bé hydrochloric acid, 113.5 parts water (by weight). Anodes are largely duriron, and the object being descaled is the cathode. The current density is 60 asf (6.3 amp/dm²), and the voltage is 4–9 volt. The time required at 60–65° C (140–149° F) is 5–10 minutes. A subsequent anodic treatment in an alkaline solution at 100° C (212° F) will remove the lead or tin film.

In other processes the metal coating produced in the pickling operation is allowed to remain. The copper strike bath is an example mentioned previously. In the Wood process[110], a nickel strike bath is utilized. A typical formulation is: $NiCl_2 \cdot 6H_2O$—36 oz/gal; HCl (22° Bé)—16 fl oz/gal. The bath is used at 20° C (68° F) with a cathode current density of 50–75 asf (4.6–7.0 amp/dm²). Stainless steel articles pickled and preplated in such a manner will readily accept inherent plates of many metals.

Anodic pickling may be used as an etch treatment prior to plating, especially for steel articles, as in the Madsenell process[103]. In addition, anodic acid treatment may be utilized for electropolishing, which serves as a substitute for mechanical pol-

ishing or buffing, either of finished articles or articles to be subsequently plated[14,41,86,180]. Concentrated acid baths and high current densities are generally employed. The mechanism of the process appears to depend upon the fact that elevated portions of a rough surface are more rapidly attacked than depressed areas. Mixtures of sulfuric and phosphoric acids are effective on steel articles, as, for example, 40 per cent H_2SO_4 + 40 per cent H_3PO_4 (by weight) at 80–90° C (176–194° F), with an anode current density of 250–500 asf (23–46 amp/dm²).

3. *Cyanide descalers*

The cyanide cleaning bath discussed previously will remove not only grease but certain oxides as well. Hence, metals to be plated in a cyanide bath are often given a brief cyanide dip (dilute solution of sodium cyanide) prior to immersion in the plating bath.

4. *Fused salt descalers*

Various fused salt descaling processes are also known. In the Tainton process[144,179], metals are cleaned electrolytically in a bath of fused caustic soda or caustic potash or hydroxide of any other metal more electropositive than the metal being treated. If a lower temperature is desired, an alkali-metal salt such as sodium nitrite may be substituted. The article being treated is cathodic, descaling occurring as a result of the reducing action of the active metal released at the cathode. The temperature of the bath is below the boiling point of the liberated metal and considerably above the fusion point of the bath, Nickel anodes are often used. Sometimes, a preliminary anodic treatment in the same bath serves to oxidize residual grease, carbon, etc., to render descaling more effective. An example of such a bath for ferrous objects is NaOH at 350° C (660° F) for 30 seconds at 100–200 asf (10.8–21.6 amp/dm²). After rinsing (explosion hazard!), the object is treated anodically in a 20 per cent (by weight) H_2SO_4 solution at 100 asf (10.8 amp/dm²) and then electroplated.

It is also possible to utilize the Tainton process without the use of current. A variant of this method[144] is soaking in fused caustic soda at 500° C (930° F) in the presence of 5–10 per cent oxidizing agent.

In recent years, duPont, in seeking new outlets for metallic sodium, developed the sodium hydride descaling bath[1,19,20,47,50]. The bath consists of caustic soda containing 1.5–2 per cent (by weight) sodium hydride and is operated at 370° C (700° F). All metals and alloys which do not react with fused caustic and can stand the temperature can be treated. This method has been used on alloys of chromium, copper, nickel, wolfram, and cobalt, as well as on plain carbon steel.

5. *Reducing atmospheres*

The use of reducing gases at high temperatures to remove oxides from metals has been suggested by Bromberg[19]. In this process, objects requiring heavy pickling can have much of their scale removed by coating with an aqueous solution of 1.3 per cent (by weight) sodium fluoride and 8.3 per cent (by weight) sodium chloride and passing through a furnace having a reducing atmosphere at 980–1200° C (1800–2190° F). The scale is rendered flaky, and a subsequent brief pickle in 15–25 per cent (by weight) hydrochloric acid suffices to remove it.

(To be continued)

Frank C. Rushton

Frank Charles Rushton died at the age of 73 in the Veterans' Administration Hospital at Sawtelle, Calif., on October 18. The cause of death, bronchial congestion, was connected with a World War I injury, obtained when the then Sergeant Rushton was shot through the right lung during action in France. Almost dead he was picked up from the battlefield only by chance.

He leaves two sisters who live in England, a stepson, Dr. S. T. Mayes of Alhambra, Calif., and a stepdaughter in San Francisco.

The body was laid to rest in Valhalla Cemetery where Military rites were executed by his Legion post members. Clarence E. Thornton, John L. Merigold, Stanley M. Rynkofs, Don M. Bedwell, Ernest W. Francis and Marcus D. Rynkofs, members of the Los Angeles Branch, A. E. S. served as pallbearers.

Rushton was born in Worcester, England, on May 29, 1877 and came to this country in 1897, settling in St. Louis. There he was employed by the Charter Oak Stove and Range Company, first in the polishing department and later as a plater. His health forced him to move to California in the early 20's. He represented the Lasalco, Inc. as Pacific Coast Sales Representative until he retired in 1946. After a six months' rest he associated himself with the Liberty Plating Company as Production Superintendent of the Tubular Division, until his physician advised him to retire to Sawtelle.

Rushton has left a heritage of notable accomplishments in the industry which he served for over a half a century. His greatest interest, the American Electroplaters' Society, he served first in St. Louis and later in Los Angeles. Several platers' associations in Los Angeles had gone on the rocks before Rushton gathered about twenty-five shop owners and platers to their first meeting early in 1929. They became Charter Members of the Los Angeles Branch. The idea of an educational society took root quickly, and under Rushton's leadership the Branch grew so that by October 18, 1930 it had on its roster ninety-four members. At the Branch's second annual meeting on this date 350 men filled the Westgate Lodge Hall. This successful affair occurred exactly twenty years before his death.

Rushton also assisted in the formation of the San Francisco Branch. With the officers of the Los Angeles Branch he corresponded with members in Australia and created sufficient interest among the platers "down under" that the Melbourne, Sydney and Adelaide Branches soon were established. Thus he was greatly responsible for the formation of five new Branches, with a total present membership of 543.

For his untiring efforts and outstanding achievements in behalf of the industry and the Society, he was awarded, at the 1948 Convention, a distinction which he cherished more highly than any other honor—election to Honorary Membership in the American Electroplaters' Society.

I. F. C. News

REPORT TO MEMBERS

At the Annual Meeting of the International Fellowship Club, held in Boston in June, 1950, your President-elect, George L. Nankervis, appointed a special committee to formulate plans and inaugurate methods for a closer association with the American Electroplaters' Society.

Your President appointed the following as a working committee: Mr. A. P. Munning, Mr. D. X. Clarin, Mr. W. D. MacDermid, Mr. A. N. Braun, Mr. R. J. Hazucha, Mr. T. A. Trumbour, and Mr. Manson Glover as special secretary of this committee.

This Committee formulated a questionnaire, and with the help of Tom Trumbour and his office these questionnaires were sent to all members of the I. F. C. We received an amazing number of replies. On Saturday morning,

Nankervis

December 2, your committee met at the Detroit Athletic Club. It spent the entire day reviewing and condensing these replies and formed a set of policies which we have submitted as recommendations to the executive officers of the American Electroplaters' Society. These opinions were with direct reference to the financing of future National Conventions.

You might be interested to know that the replies were practically unanimous in the opinion that they favored a definite, restricted Convention budget with reference to entertainment. Also, they were practically unanimous in the opinion that the registration fees should cover approximately 75 per cent of the Convention budget.

In the immediate future, your committee will submit a complete copy of our official report to the American Electroplaters' Society, which will be available to all interested parties. This report will cover the complete set of recommendations adopted at this meeting.

This Executive Committee acted upon several other important matters:

1. It instructed our Secretary to proceed with the necessary papers for immediate incorporation of the International Fellowship Club.
2. It instructed our Secretary to make arrangements for necessary liability insurance covering many future social functions of the International Fellowship Club.
3. It recommended that the International Fellowship Club seriously consider and act upon recommended methods of furnishing financial support to the Public Relations Program of the American Electroplaters' Society.

In this matter, we are happy to report that Mr. W. M. Phillips, of the General Motors Corporation, attended this special committee meeting. He expressed his complete satisfaction and appreciation of the efforts that this committee proposed to instigate with reference to public relations.

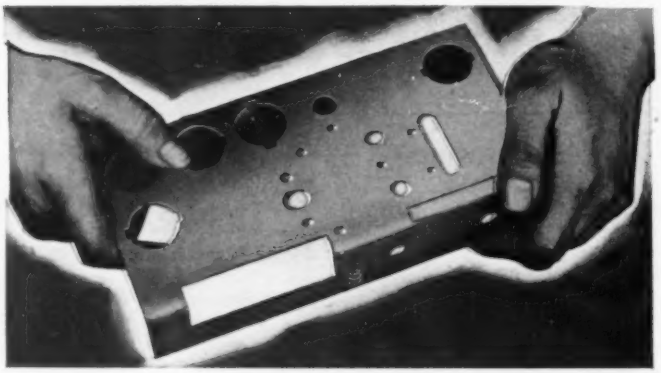
Mr. Clyde Kelly, Chairman of the 1952 Exhibition Committee, also attended our committee meeting. He has advised that the Chicago Branch is going ahead with full plans for a successful exhibition to be held in conjunction with the Chicago Convention in 1952.

Your committee, before adjourning, agreed to accept with gratitude the offer of PLATING, "Metal Finishing", and "Products Finishing", of space in their magazines for future reports on I. F. C. proceedings.

We have recommended to the A. E. S. that at subsequent Conventions the International Fellowship Club be allowed the afternnon of Monday, from one to three, for business sessions, because it is our opinion that we will have many interesting matters of business to discuss at future Fellowship meetings.

Respectfully submitted,

G. L. NANKERVIS



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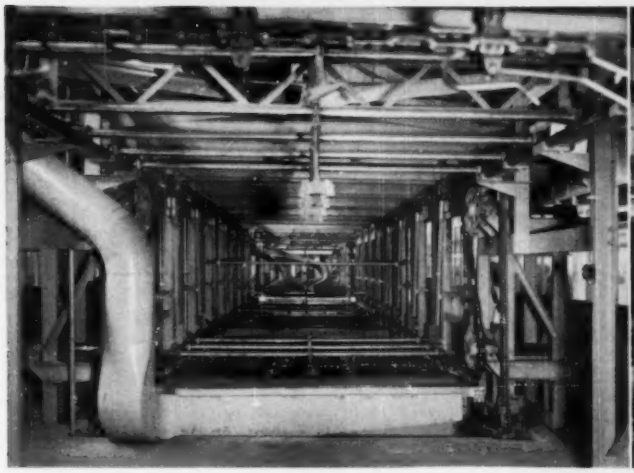

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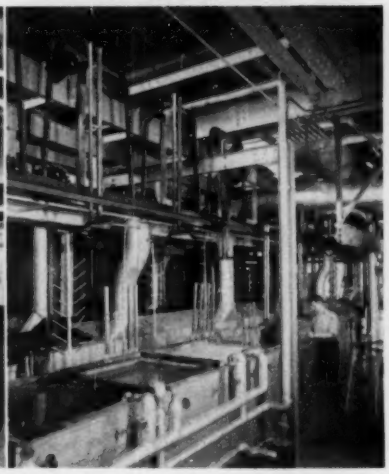

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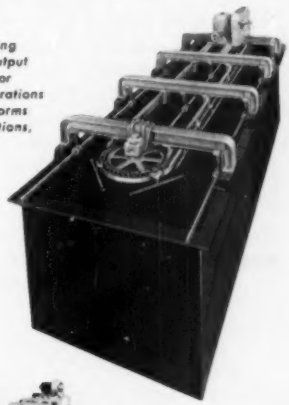

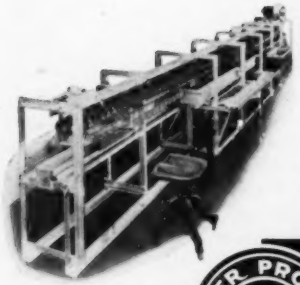

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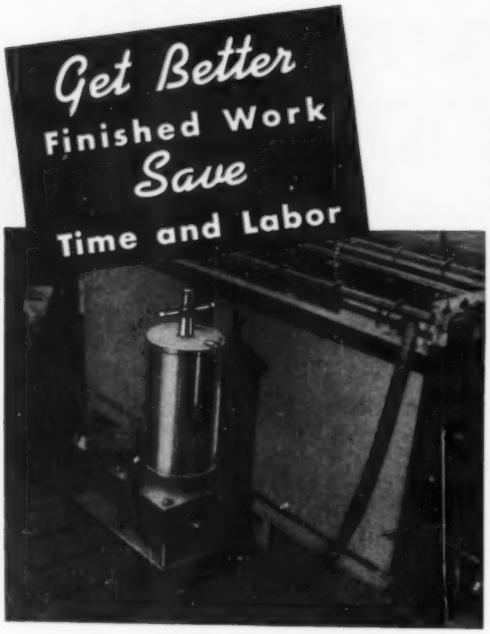

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readers' questions of general interest

Q. 106. We are unable to obtain nickel chloride to maintain the chloride content of our nickel solutions. What should we do?

A. To the extent that the *p*H needs adjustment with acid, one can add hydrochloric acid. A quart of 23° Be hydrochloric acid (laboratory grade) is equivalent to about 3.1 lb of $NiCl_2.6H_2O$. Unfortunately, if the chloride content of the solution is low the anode efficiency is low which results in a lowering of *p*H.

It is also possible to add a soluble chloride other than nickel chloride. Sodium and potassium chloride are considered objectionable because of the effect of the alkali metal ions on the character of the plate, especially in bright-nickel plating solutions. Magnesium chloride offers more promise, but its use in bright nickel solutions should be cleared with the vendor.

Finally it is possible to increase the chloride content by means of a porous cup. The hydrochloric acid is put in the cup with a small nickel anode and the assembly is hung on the anode rod of the plating tank. The current dissolves the nickel anode to form nickel chloride, and when the *p*H within the cup reaches 5.0, the contents of the cup is poured into the bath. The operation is repeated until the chloride concentration in the bath reaches the desired value. In a variant of this method the porous cup with its hydrochloric acid and nickel anode is hung in a battery jar with dilute sulfuric acid and a lead anode. This cell (outside the tank) is then connected with a source of current to produce nickel chloride as before. I believe the former method the more convenient.—A. K. GRAHAM

A. We do not have a great deal of information about the use of magnesium chloride in our bright-nickel solution. Up to 2–3 oz/gal have little effect, but we are under the impression that higher concentrations will cause the deposit to become somewhat brittle.

We must remember that chloride is not the only limiting factor. If the nickel is low, the current density is certain to be limited and the addition of chlorides other than nickel chloride will have very little effect on the limiting current density. If the nickel content is sufficiently high, the nickel chloride content can be increased and the nickel sulfate correspondingly decreased by adding hydrochloric acid which will lower, the *p*H of the solution, and then neutralizing with lime, which will return the *p*H to its normal value and precipitate calcium sulfate. The total effect will therefore be an increase in chloride ion and a decrease in sulfate ion. Lime must be used cautiously because there is serious danger of precipitating nickel in a orm very difficult to redissolve.—R. B. SALTONSTALL.

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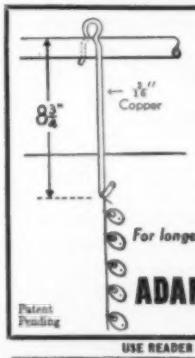

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Article Abstracts

For copies of original articles, turn to your Public Library for photostats or addresses of the publications in question

Treatment of Waste Waters from the Pickling of Steel. G. E. Eden and G. A. Truesdale. J. Iron Steel Inst. (London) **164,** 281–284 (March, 1950).

Experiments of Gehm on neutralization of dilute solutions of sulfuric acid by upward flow through a bed of limestone grit were extended to show that the limiting concentration of acid that can be satisfactorily neutralized is dependent on temperature of solution. When the method was applied on a laboratory scale, it was found that it might be of value in reducing acidity and would have the advantage that large volumes of waste water could be treated in a comparatively small plant.

Surface Treatment and Finishing of Light Metals. V. S. Wernick and R. Pinner. Sheet Metal Inds. **27,** 355–362 (April, 1950).

Continues description of various patented processes. The Pylumin, Alrok, Alodine, Alocrom, Jirotka, Pacz, Protal, McCulloch, and two new German (V. A. W.) processes are described as examples of chemical oxidation processes. Applications of these coatings in organic finishing, deposition of copper on an oxide coating, and treatment of aluminum-alloy castings containing heavy-metal inserts are then reviewed. 21 ref. (To be continued.)

Corrosion of Electrodeposited Nickel; Resistance to Water Containing Dissolved Carbon Dioxide and Air. Leonard C. Flowers and James B. Kelly. Ind. Eng. Chem. **42,** 719–727 (April, 1950).

Experimental investigation showed that nickel electrodeposits from baths containing salts of naphthalene disulfonic acids are dissolved rapidly and continuously at room temperature by the above. Corrosion rates range from 25 to 96 mg/dm² per day. Electrodeposits from baths containing no brightening agent may be pitted under these conditions but do not corrode rapidly;

neither does rolled sheet nickel. Mechanisms are discussed. 14 ref.

Influencing the Electrical Deposition of Metals by Means of Cathodes Vibrating at Different Frequencies, Especially in the Range of Ultrasonic Frequencies. Fr. Muller and H. Kuss. Helv. Chim. Acta **33**, 217–228 (February 1, 1950).

Surveys literature on the above. Experiments on copper, nickel and chromium electrodeposits show that the method improves the adhesion, hardness, and tensile strength of the metal deposits and increases the current yield. Includes illustrations, graphs, and numerous references.

Chromium is Plated Directly on Aluminum by New Process. T. C. DuMond. Materials & Methods **32**, 56–57 (October, 1950).

Brief description of the process, which is based on the use of an abrasive material in wet blasting. After being blasted, the aluminum surface retains a coating of the suspension thick enough to prevent any action by air on the mechanically cleaned aluminum for a period long enough to permit the aluminum to be immersed in the plating bath, where the coating washes away and settles to the bottom.

Relation Between the Continuity of Oxide Films and Roughness of Aluminum Surfaces. A. V. Shreider. Zhur. Fiz. Khim. **24**, 455–458 (1950); Chem. Abs. **44**, 8268–8269 (September 25, 1950).

Corrosion resistance of aluminum anodically oxidized in 3 per cent CrO_3 was severe for polished metal (average height h of asperities, 0.28 μ), less for ground (h = 2.4 μ), and least for sand-blasted metal (h = 5.6 μ); two aluminum alloys showed analogous behavior. The weight loss during anodizing increased with roughness. Anodizing in CrO_3 solutions (3–9.5 per cent) increased h of polished aluminum alloy by 0.025–0.15 μ, but anodizing in 20 per cent H_2SO_4 and in 5 per cent oxalic acid increased it by 0.15–0.9 μ; current density was 5.6–32.5 asf (0.6–3.5 amp/dm^2) at 10–40 volts, and duration of test 15–40 minutes.

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The potential V of polished aluminum anodized in 20 per cent H_2SO_4 was not very different from that of nonanodized aluminum, because the oxide film on the rough surface was not continuous; but anodizing in 3 per cent CrO_3 shifted V by 0.25 volts. Anodizing of sandblasted aluminum in CrO_3 had but little effect on V.

Quantitative Studies of the Anodic Oxidation of Aluminum. Bimal Chanda. Trans. Indian Inst. Chem. Engrs. **1**, 67–71 (1947–1948); Chem. Abs. **44**, 8264-65 (September 25, 1950).
Oxide coatings were formed on sheets of 99.4 per cent aluminum foil by electrolysis. Increasing the electrolyte concentration from 10 to 20 per cent H_2SO_4 had little effect on thickness of the oxide film but increased the amount of aluminum dissolved in the electrolyte. Raising temperature from 85° to 105° F resulted in marked increase in dissolved aluminum and in formation of a more porous and lighter film which was unsuitable for dyeing. Thickness of film increased almost linearly with oxidation time, but rate of aluminum solubility also increased. Higher current densities reduced solubility of aluminum and produced heavier and denser films. Comparison of 15 per cent H_2SO_4, 3 per cent oxalic acid and 10 per cent chromic acid showed nearly the same current efficiencies but decreasing film efficiencies in the order named. Dyeing tests were made wi Brilliant Croceine 9B. The optimum dipping time was 5–10 minutes. The amount of dye absorbed was not affected by dye concentration but was almost linear with oxidation time (thickness of oxide film).

Decorative Chromium Plates with Agate-like Colored Bands or Other Markings. V. T. Safron'ev. Stanki I Instrument **21**, No. 3, 21 (1950); Henry Brutcher, Altadena, Calif., Translation No. 2590.
Particulars are given on a decorative chromium plating process, claimed to have been developed in the Soviet Union, which gives a deposit looking like dark polished agate, or nephrite. Surface preparation, bath composition, conditions of deposition, aftertreatment of deposit, and properties of deposit are included.

1-1-50

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Patent Abstracts

GEORGE B. HOGABOOM

Consultant, New Britain, Conn.

Copies of patents may be obtained by writing to Commissioner of patents, Washington 25, D.C. Price 25 cents each.

No. 2,521,580, September 5, 1950—Coloring Stainless Steel—Regina R. Hornak and John J. Halbig, assignors to Armco Steel Corporation.

Upon heating 11.5 to 13.5% chromium stainless steel products by immersion in a boiling aqueous bath under operating conditions differing from product to product to the extent of phosphoric acid concentration used, somewhat different colors develop because of the particular concentration and especially in view of treatment time. Some idea of the variety of color obtained with different times of immersion in several dilutions of phosphoric acid are noted in the table below. In these instances the depth of color corresponding to a given treating time increases somewhat with concentration of the acid . . .

Time of Immersion hours	*Quantity of Phosphoric Acid by Weight of Solution*		
	0.5%	1%	2%
1/3	Bronze-gold	Bronze-gold	Bronze-gold
2/3	Mulberry	Mulberry	Mulberry
1	Indigo	Indigo	Indigo
2	Turquoise blue	Turquoise blue	Turquoise blue
3	Pale green	Aqua green	Aqua green
16	French blue	Purple	Magenta

CLAIM 3. In coloring stainless steel essentially containing about 10 to 35% chromium, the art of producing a thin, adherent surface film thereon ranging in color from yellow to purple which comprises immersing the steel in a solution essentially consisting of about 0.25 up to 5% phosphoric acid by weight and the remainder substantially all water, with said solution at approximately boiling temperature, and employing a period of immersion ranging upward from 20 minutes' time to more than 20 hours depending upon the color and hue desired.

5 claims.

References cited: U. S. Patents 2,059,783; 2,172,422; 2,426,445. Ind. Eng. Chem. **23,** 140–150 (February, 1931). Thum, "Stainless Steel", 2nd ed (1935), pp. 173–174.

No. 2,525,943, October 17, 1950—Copper Plating and Processes—W. A. Proell, assignor to Standard Oil Company, Chicago, Ill.

CLAIM 5. A process for electrodeposition of copper which comprises electrolyzing an aqueous solution of a copper alkanesulfonate having between 1 and 5 carbon atoms, inclusive, in the alkyl group, said solution containing at least about 100 grams of dissolved copper per liter and at least 5 but not more than 10 grams per liter of uncombined alkanesulfonic acid having between 1 and 5 carbon atoms, inclusive, in the alkyl group, at a temperature between 120° F and about 150° F and a current density of 500 to 800 amperes per square foot.

6 claims, 1 diagramatic chart illustrating chemical and electrical conditions for electrodepositing copper and characteristics of deposit.

References cited: U. S. Patents 2,111,575; 2,294,053. Blum and Hogaboom, "Principles of Electroplating and Electroforming" (1930), pp. 89, 90 and 93.

No. 2,526,951, October 24, 1950—Method of Electrolytic Polishing—J. M. Kiefer, Jr., assignor to American Steel & Wire Company.

This invention relates to a method for electrolytic polishing and more particularly for polishing steel specimens for metallographic examination.

CLAIM 1. The method of electrolytically polishing metal specimens which comprises suspending the specimen a slight distance above the top of the electrolyte, agitating the electrolyte to cause it to wash across the bottom surface of the specimen to polish said bottom surface while maintaining the mean level of said electrolyte a short distance below the said bottom surface, and passing current through the electrolyte during said agitation with the specimen being the anode.

3 claims, 5 figures.

References cited: U. S. Patents 1,242,695; 1,800,947. Metal Ind. **62,** 69 (January 29, 1943). Stahl u. Eisen **61,** No. 8, 185, 186, 187 (February 20, 1941). Iron Age **146,** 26 (December 26, 1940); **144,** 30–32, 66 (December 21, 1939). Metal Progress **49,** No. 3, 537, 538 (1946).

No. 2,526,999, October 24, 1950—Cadmium Plating—Myron B. Diggin and Otto Kardos, assignors to Hanson-Van Winkle-Munning Company.

CLAIM 1. An alkali-cyanide cadmium plating bath containing in solution as addition agents an oxyheterocyclic compound selected from the group consisting of furfuryl alcohol, tetrahydrofurfuryl alcohol, alkali furyl acrylate, furcin, furyl nitroethylene, and a bath-soluble caustic alkali-fufural resin, in amounts from about 1 to 20 g/l, and said cyanide cadmium bath also containing in solution 0.025 to 0.2 g/l hydroethyl cellulose.

CLAIM 2. . . . containing in solution as addition agent a bath-soluble nickel salt in amounts substantially equivalent to 0.09 to 0.027 g/l of nickel. . . .

2 claims, 5 examples.

References cited: U. S. Patents 1,681,509; 1,893,368; 2,107,806. German Patent 704,989. Trans. Electrochem. Soc. **79,** 335–340 (1941).

No. 2,528,601, November 7, 1950—Copper-Tin Alloy Plating —Frederick A. Lowenheim, assignor to Metal & Thermit Corporation.

EXAMPLE 1. Method of making a solid copper-tin mixture in which the copper exceeds the tin. The following compounds in the indicated amounts were mixed:

No.	Compound	Weight	Copper-tin ratio
1	Copper stannate	230 (1 mol)	64:118
2	$CuCO_3$	124 (1 mol)	128:118*
3	$Cu(OH)_2$	76 (.78 mol)	177:118†

*Sum of Nos. 1 and 2

†Sum of Nos. 1, 2, and 3

The ratio of 177:118 is substantially a 60:40 ratio, it having been found that a bath of this ratio produces a satisfactory copper-tin alloy plate. It is to be understood, of course, that copper stannate may be employed with $CuCO_3$ alone, or with $Cu(OH)_2$ alone, and that other Cu-Sn ratios may be similarly obtained.

CLAIM 5. Method of electroplating a copper-tin alloy from a plating bath with which only a single anode circuit is used, said bath containing an aqueous solution of alkali metal cyanide and alkali metal hydroxide and having copper and tin dissolved therein, which comprises regenerating the bath by adding copper stannate thereto, and plating said alloy from said bath, said copper stannate having been formed as a precipitate by adding copper sulfate to a solution containing alkali metal stannate.

8 claims, 3 examples.

References cited: U. S. Patents 1,970,548; 1,970,549; 2,079,842; 2,198,365; 2,216,605; 2,397,522. Mellor, "Treatise on Inorganic Chemistry", Vol 7, p 418 (1927).

No. 2,528,717, November 7, 1950—Method of Electroplating Stainless Steel and Irons—Clement Batcheller.

CLAIM 1. The method of plating the surface of a stainless steel alloy containing at least 7 per cent, by weight, of chromium which comprises forming in and integral with said surface an adherent, dark-colored film of oxide by merely immersing said steel in solution containing, by weight,

	per cent
Water	35–55
Free sulfuric acid (1.84 sp gr)	15–55
Chromic acid	2–20
Iron sulfate	0.10–10
Chromium sulfate	0.01–10
Minor quantities of other sulfates and bisulfates and impurities	balance

and thereafter electroplating said oxide-film surface with copper in an alkaline electrolyte.

CLAIM 2. The method set forth in Claim 1 in which the treating solution is maintained at a temperature between 180° F and about 220° F.

2 claims, 1 figure.

References cited: U. S. Patents 1,774,269; 2,133,255;

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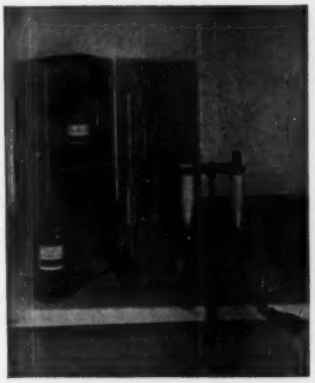

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2,172,353; 2,219,554; 2,285,548; 2,293,810; 2,363,973; 2,375,210. British Patent 458,940. J. Electrodepositors' Tech. Soc. **14**, 47, 48 (1937–1938); **13**, 1, 2, 8 (1937).

No. 2,528,902, November 7, 1950—Bright Nickel Plating—P. W. Moy and W. P. Karash, assignors to The Harshaw Chemical Company.

EXAMPLE 1

$NiSO_4.7H_2O$	240 g
$NiCl_2.7H_2O$	40 g
H_2BO_3	40 g
Nickel thiophene sulfonate	0.15 g
Water to make 1 liter	
Temperature	140° F
Current density	50 asf
*p*H	3.5
Character, semi-bright, ductile	

EXAMPLE 2

. . .

Nickel thiophene sulfonate	0.5 g

EXAMPLE 3

. . .

Thiophene sulfonic acid	0.15 g
Ethylene cyanohydrin	0.3 g

EXAMPLE 4

. . .

Thiophene sulfonic acid	0.15 g
Reduced fuchsin	0.005 g

EXAMPLE 6

. . .

Thiophene sulfonic acid	0.15 g
Sulfonated napthalene	4 g
Reduced fuchsin	0.005 g

Deposit was fully bright in spite of impurities which with the same consituents except thiophene sulfonic acid caused a gray deposit in recessed portions.

CLAIM 1. An aqueous acid electroplating bath for production of a bright cathodic deposit of nickel, said bath essentially consisting of a nickel-ion-yielding material selected from the group consisting of nickel sulfate, nickel chloride and mixtures thereof, a buffer and, as an addition agent, a material of the class consisting of thiophene sulfonic acid and its alkali metal, nickel and cobalt derivatives wherein the metal atom replaces the hydrogen atom of the SO_3H group, said addition agent being present in concentration from 0.005 gram per liter, the *p*H of said solution being from 3.0 to 5.0.

CLAIM 2. . . . additional brightening agent of the class consisting of aliphatic nitriles having 1 to 10 carbon atoms and aromatic nitriles having from 8 to 10 carbon atoms.

CLAIM 3. . . . wherein is also contained an aromatic sulfonate of the class consisting of mono-, di-, and tri-sulfonic acids of benzene, naphthalene and diphenyl, their alkali metal, nickel and cobalt salts and chloro, amino and methyl derivatives, the corresponding sulfonamides, saccharine and its sodium salts.

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Patent Abstracts

7 claims, 6 examples.

References cited: U. S. Patents 2,085,754; 2,427,280. British Patent 506,332. Trans. Electrochem. Soc. **80**, 544, 545, 546, 547, 563 (1941). Metal Finishing **39**, 611 (November, 1941). Metal Industry **65**, 331 (November 24, 1944). Richter, "Organic Chemistry" (1938), pp. 649, 650. Karrer, "Organic Chemistry", 2d ed (1946), p. 743.

No. 2,529,086, November 7, 1950—Method of Making Fine Mesh Screens—H. B. Law, assignor to Radio Corporation of America.

CLAIM 1. The method of forming a fine mesh screen which comprises forming grooves of a predetermined screen pattern in a surface of a hard ceramic plate, cathode sputtering a very thin layer of metal consisting essentially of about 1 part bismuth, 7 parts palladium and 25 parts gold over said surface and in said grooves, removing the metal from the ungrooved portion of the surface, electroplating from a neutral acid bath a substantial thickness of another metal over the sputtered metal in said grooves, and stripping the formed screen from said plate.

CLAIM 2 (3). The method in Claim 1 in which said second deposited metal is copper (nickel).

CLAIM 4. The method in Claim 1 in which said sputtering operation is carried out in an atmosphere having a relative humidity of 40 to 50 per cent.

8 claims, 7 figures.

References cited: U. S. Patents 313,805; 678,383; 1,563,731; 1,994,668; 2,067,502; 2,166,366.

No. 2,530,842, November 21, 1950—Manufacture of Metal to Metal Duplications—E. P. Ruggieri, assignor to Radio Corporation of America.

CLAIM 1. In a process of making master molds used in the manufacture of disc sound records, the steps of passivating a metal replica of an originally recorded sound groove by treating said replica with an aqueous solution of a strong oxidizing agent from the class consisting of alkali metal dichromates and permanganates, said metal having a surface of one of the class consisting of gold, silver and platinum, rinsing said passivated surface with water at temperatures of 35 to 100° F for about 3 minutes to about 5 seconds, electrodepositing a coating of nickel on said passivated surface and then stripping said nickel coating from said passivated surface.

CLAIM 3. A process according to Claim 2 in which the concentration of the potassium dichromate solution is about 2.2 grams/liter.

CLAIM 5. . . . with an aqueous solution of potassium permanganate having a concentration of at least 0.22 gram/liter. . . .

5 claims, 3 figures.

References cited: U. S. Patents 454,381; 2,323,424; 2,325,660. Electrometallurgy Supplement to the Metal Industry (London) **49**, 265, 266 (September 11, 1936).

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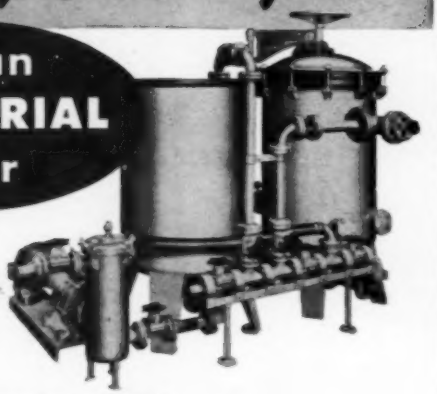

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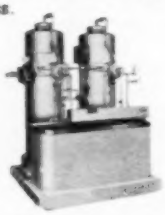

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A. E. S. News

New Sustaining Members

Several concerns have recently demonstrated their interest in the A. E. S. Research Program by taking out sustaining memberships. They are :

Harding Manufacturing Company, Detroit, Mich.

Modern Plating Corporation, Freeport, Ill.

Monsanto Chemical Company, Merrimac Division, Everett, Mass.

Reilly Plating Company, Melvindale, Mich.

With these additions, the number of sustaining members is 243. They hold between them 281 memberships.

A. E. S. Liaison to American Standards Association Committee

E. R. Bowerman and M. B. Diggin have been appointed by President W. J. Neill as liaison representative and alternate respectively to Committee Z9 of the American Standards Association. In their capacity as liaison to this group they will represent the Society's interest in the preparation of standards applicable to the electroplating industry. They have already rendered service in the development of a standard dealing with open-tank ventilation.

Law Committee Appointment

Manson Glover, Chairman of the Law Committee, has appointed Earl Coffin of the Los Angeles Branch to serve as a member of the Committee in connection with the Los Angeles Convention.

A. E. S. Research Policy

At the Research Committee meeting in Hotel Statler, Detroit, on December 2, Dr. W. A. Wesley, Chairman of the Committee, appointed a Special Policy Subcommittee to prepare a policy bulletin codifying the Committee's policies and procedures. Included is the handling of information and data originating with projects prior to publication in PLATING or the *Proceedings*.

Members of the new subcommittee are W. M. Tucker, Chairman; B. C. Case, S. M. Cole, and Dr. R. A. Schaefer.

Members in the Armed Forces

At its meeting on December 2 and 3 in Detroit, Mich., the Executive Board decided to put back into effect the policy followed during the last war. A member of the Society who has entered the Armed Forces will be exempt from payment of dues and will remain in good standing until he has been released from service. He will not receive the Society's publication during this period.

Branch News

CHICAGO BRANCH

ANNUAL EDUCATIONAL SESSION AND PARTY
Saturday, January 27, 1951
Stevens Hotel

Symposium on "Preparation of Metals for Electroplating" at 2:30 P. M.

Speakers: Mr. C. F. Nixon, Ternstedt Division, General Motors Corporation, Detroit, "Polishing and Buffing"
Dr. Foster D. Snell, Foster D. Snell, Inc., "Emulsion, Solvent, and Alkaline Cleaning"
Dr. Cloyd C. Snavely, Battelle Memorial Institute, Columbus, Ohio, "Pickling and Bright Dipping"

Banquet at 7:30 P. M.
Dinner—Entertainment

Tickets from Paul Glab, 882 N. Pauline Street, Chicago, Ill.

Room reservations in Stevens Hotel: Mention attendance at A. E. S. party

R. F. LEDFORD, *Correspondent*

DAYTON BRANCH

ANNUAL EDUCATIONAL SESSION AND DINNER-DANCE
Saturday, March 3
Biltmore Hotel

Educational Program in Afternoon
Banquet in Evening

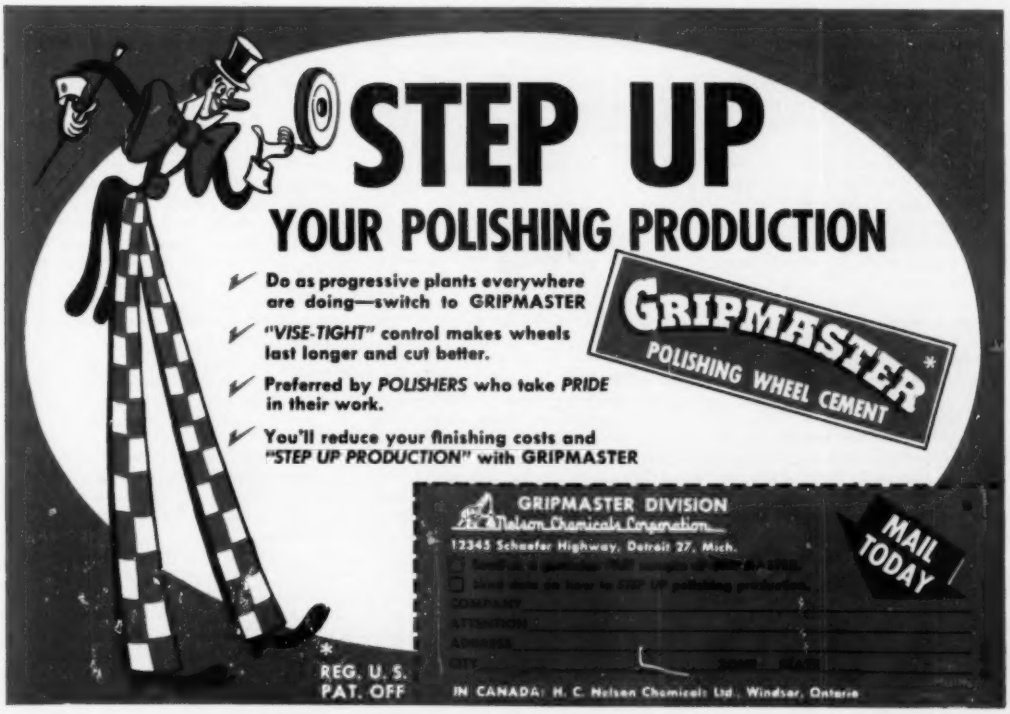
Tickets at $6.00 from Paul E. Gaske, 41 S. Bromfield Road, Dayton 9, Ohio.

HERMAN E. AUSTEN

BALTIMORE-WASHINGTON BRANCH

The fall season of Branch activities opened with a plant tour of one of the largest electrolytic copper refineries in the world. During the afternoon of October 10 the Baltimore plant of the American Smelting and Refining Company was host to thirty-one Branch members and guests. The trip followed the sequence of operations for converting blister copper (99 per cent Cu) to refined metal of 99.99 per cent purity. After drill sampling for precious metal assay, the pigs of blister copper are melted in reverberatory furnaces for casting into anodes. Most of the refined copper is recovered and sold in the form of cathode plates, the remainder is melted and cast into molds for rolling or drawing. A precious-metals recovery unit extracts silver and gold from the electrolytic-tank slimes, and selenium and tellurium compounds are recovered from slags. Special laboratory techniques are employed for process control, one of special note being photomicrographic examination of copper in which the appearance of grain boundaries is indicative of oxygen content. Souvenir key chains were presented to those attending, all of whom were grateful for the hospitality extended.

On November 7 MR. ROBERT TIERS of the Whitemarsh Laboratories, Pennsylvania Salt Manufacturing Company, gave an enlightening discussion of "Trouble Shooting in Alkaline Cleaners". Acknowledging that metal cleaning is still more art than science, the speaker stressed the need for defining the conditions which exist when trouble is encountered, a procedure which often results in bringing to light unusual and unaccounted-for variations from standard. Changes in type of surface soil to be removed, usually due to prior process modifications, are common causes of trouble because the metal-cleaning department is rarely kept advised and in position to alter cleaner formulations accordingly. The speaker deplored the lack of cleaner evaluation methods, especially any which might be suitable for plant control. The recently developed water spray and swirl techniques for soil removal were described, as was a timed-cycle automatic device employed experimentally for measuring the useful life of cleaning solutions. Mr. Tiers pled for the development of standardized soil compositions, so that work carried on by different investigators might produce comparative date. Active discus-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sion of the subject carried on into the informal thirst-quenching session which followed.

Responding to the request of the A. E. S. Executive Board Mr. K. M. Huston spoke briefly on the importance of maintaining high quality in plated-ware production in spite of the current shortage of nickel. Reference was made to the outdoor-exposure data on copper-nickel-chromium coatings now being accumulated by A. S. T. M., showing that substitution of an equal thickness of copper for nickel may produce undesirable results. For more specific information platers were referred to the personnel of Subcommittee H of A. S. T. M. Committee B-8.

January 9 will bring A. E. S. President Neill to a dinner meeting in Baltimore for the traditional induction into the Order of the Pot.

George E. Best, *Secretary*

BOSTON BRANCH

The meeting on November 12 was held in the Statler as usual. Kenneth R. Corson submitted his resignation as Second Vice-President, and Rudolph Helgeson was elected in his place and installed by Past President Louis V. Gagnon. Joseph T. Sullivan was appointed chairman of the 1951 Annual Technical Session and Banquet to be held in the Statler on April 7 and will choose his own committee.

The librarian then presented Mr. Hubert Goldman, ably pinch hitting for Dr. Walter R. Meyer, of Enthone, Inc., New Haven, Conn. Discussing "Bright Dipping of Metals" he presented with the aid of slides an excellent story of pickling and bright dipping and explained how they are thought to work. The various acids alone and in combination were treated, together with the rates of attack and the time required for brightening of the surface. Plots were presented for the various mixtures. Aluminum, as might be expected, was the major example presented. Reference was made to the 1949 *Proceedings* for papers bearing on the subject. Following adjournment there was an informal question period.

George P. Swift, *Secretary*

BRIDGEPORT BRANCH

Thirty-five members and guests attended the business meeting on October 6.

The Sick Committee reported the passing of John C. Oberender, formerly a member of the Branch and more recently with the New Haven Branch. Sympathy was expressed to the bereaved family. The Membership Committee reported three applications for membership.

At the request of the Engineers' Club of Bridgeport, President A. J. Chenis appointed Phil Bailin, Ray Goral and himself to attend a meeting on October 25 to explore the possibility of forming a Bridgeport Engineering Council.

It was voted to hold a combined business meeting and open session once a month. The second Friday will be the regular meeting time, but it may be changed at times at the discretion of the librarian. It was also voted not to participate in this year's Regional Meeting.

Mr. H. M. Goldman of Enthone, Inc., New Haven, Conn., then discussed some of his experiences in the finishing field, especially of troubles caused by poor water, bath impurities, tryout of new methods and materials, and plain inexperience. Many questions which followed the fine talk were answered to everyone's satisfaction.

J. G. Sterling,
Secretary-Treasurer

BRIDGEPORT BRANCH

Richard C. Barrett served as Technical Chairman at the Open Meeting and Educational Session on October 20, attended by forty-five members and guests. He introduced Dr. Donald Price, Technical Director of the Oakite Products Company, Inc., New York City, whose subject was "Wetting Agents and Their Application to Metal Finishing".

Dr. Price started by giving a demonstration of what happens when wetting agents are introduced in water or solutions. Wetting agents may serve as detergents, emulsifiers, cleaners, penetrating agents, and surface activators. It makes no difference whether the object is metal or non-metal, the detergent action is the same. Wetting agents are widely used in pickling, cleaning and plating. Considerable discussion followed the fine talk.

Refreshments were then served through the courtesy of Floyd C. Tatum, Oakite Products Company, Inc., New York City.

Joseph G. Sterling,
Secretary-Treasurer

CHICAGO BRANCH

At the November 10 meeting, eighty-one members and guests were present to hear Mr. William Jackson of the Udylite Corporation, Detroit, Mich., speak on "Barrel Plating Equipment and Plant Layout".

Several flow charts were used to illustrate the discussion and served to point out some of the mistakes made in laying out this equipment. Some comment was made on materials of construction of barrels. The advantages and disadvantages of separate or plating cylinders through the pre-treatment cycle were discussed. Numerous questions were answered by the speaker following his interesting and informative talk.

R. F. Ledford, *Correspondent*

CINCINNATI BRANCH

Due to Thanksgiving, the November meeting was held one week early, on the 15th. Thirty members and guests were present for the dinner which preceded the business meeting and the talk by Mr. A. G. Russell, Western Electric Company, Hawthorne, Ill.

After President E. A. Blount had welcomed two new members, one applicant was elected to membership.

Mr. Russell then talked about "Electroplating Telephone Relay Parts". Profusely illustrating his lecture with slides, he explained the important part relay parts play in the telephone system and the necessity for proper nickel and chromium plating of these parts. He showed the complete plating operation, giving a detailed picture of the plating rooms with an explanation of the methods and time periods in the cleaning and rinse baths. One-inch Polystyrene balls were preferred to rods as a means of saving chromium solution, because they do not cling to the work. Mr. Russell concluded his talk by showing the methods used in racking and pointing out the advantages of hard wiring on the racks whereby the relays could be hung on the wires rather than clipped to rods.

After a short question period, the meeting was adjourned for a Social Hour with Industrial Filter & Pump Manufacturing Company, Chicago, as host.

Charles Wise, *Secretaey*

DAYTON BRANCH

The regular meeting on November 3 at the Red Gables began with a Smorgasbord Dinner, attended by thirty members and friends

The speaker for the evening was Mr. John Kinney, Sanitation Engineer, The Ohio River Valley Water Sanitation Commission, who gave a very interesting talk entitled "Water Conservation Through Pollution Control." He presented the aims of the Commission with regards to the disposal of industrial wastes and explained the workings of the different task groups, one of which, on electroplating wastes, is headed by A. E. S. President W. J. Neill. A long and hard road will have to be traveled, but the sooner we get started, the more time there will be for finding cheap, efficient means of disposal before strict legislative measures are taken and enforced.

After the fine lecture, we were treated to refreshments and snacks. It was an evening well spent.

R. M. Clinghens, *Secretary*

DETROIT BRANCH

The regular monthly meeting was held in the Hotel Statler on November 10, following a business session of the Executive Board.

Some 200 members listened attentively as Mr. Herberth E. Head, Supervisor of Electroplating of the Briggs Manufacturing Company, discussed the interesting field of chromium plating on stainless steel. His talk was supplemented by answers to questions from the floor.

Preceding Mr. Head's address, a color motion film of "Travel Across the Andes"

was shown through the courtesy of CARL E. HEUSSNER of the Chrysler Corporation. PRESIDENT E. A. HAHN, who chairmanned the meeting, stated that all arrangements had been completed for the Annual Educational Program and December Party scheduled for December 2. Advance registrations indicated a large attendance, he stated, and a number of members of the Society's Executive Board had signified their intention to attend.

A. E. STEEGAR, *Publicity Chairman*

HARTFORD BRANCH

Approximately sixty members and guests were present at the regular monthly meeting on November 20. MR. GEORGE HOGABOOM gave a brief talk on latest developments in the plating field, and an interesting movie entitled "Atomic Power" was shown.

To encourage members to write or deliver papers, the Branch has arranged a technical-paper contest, the winner of which will be presented with a prize. The contest, which will close with the January meeting, began at this meeting with the presentation of two papers: "Anodes and Anode Rods" by George B. Hogaboom and "Plate Distribution" by WILLIAM CULLEN of the Stanley Works.

The principal speaker of the evening was MR. LOUIS GAGNON of Bart-Messing Corporation, whose subject was "Production Plating of Small Parts". He stressed the importance of proper plant layout to prevent unnecessary handling of small parts. The tumbling and bright dipping room should be placed in their proper sequence following mechanical finishing. The placing of parts on plating racks instead of trays after buffing to save time and labor, the use of air hoists to prevent electric shock in the tumbling room, design of buffing hoods that catch all dirt and dust, proper spacing of parts on racks for improved plate distribution, use of tags for identification of the type of plate to be applied, and use of statistical quality control were important factors brought out.

Refreshments were served through the courtesy of Enthone, Inc.

STANLEY PLATOZ, *Secretary*

LANCASTER BRANCH

The monthly meeting was held on November 10 in the Stevens Trade School, Lancaster, with thirty-five members and guests present.

After a short business meeting, LIBRARIAN RAY VINES introduced DR. R. B. SALTONSTALL, Technical Director of The Udylite Corporation, Detroit, Mich., who spoke about "Nickel Plating". Having given a short history of nickel plating, he stressed the advantages of bright-nickel plating: high solution tolerance to impurities; simple control; high-current-density plating; improved ductility, absence of interval stress and freedom from porosity in the plate. He then discussed several special applications of nickel plating, as well as nickel plating without anodes. In closing he mentioned several methods of conserving nickel.

After Dr. Saltonstall answered a number of questions, the meeting was adjourned.

HARRY A. SAYLOR,
Secretary-Treasurer

LOS ANGELES BRANCH

The Los Angeles Branch is hard at work laying plans and devising surprises for all who will attend the Convention this summer. The best equipped hotel, the Biltmore, has been reserved for Convention headquarters. A complete and interesting Ladies' Program, including sight-seeing tours, luncheons, style shows, and favors is being arranged; a real Western outing is being planned. Every member of the Branch is anxious to show a really good time to all "Easterners" who come.

In addition to planning a stupendous Convention, the Branch has been having very interesting monthly meetings. The November meeting, held on the 8th, had MR. CLARENCE H. SAMPLE of The International Nickel Company as guest speaker.

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Mr. Sample prefaced his talk with a few remarks on the present nickel-supply situation and then showed several series of colored slides of panels used to test various electrodeposited coatings. The first series showed the results of exposure of zinc and cadmium on steel and the effects of condensation, salt spray, heating and cooling, and outdoor exposure. The second series showed panels coated with various thicknesses of lead, and the third series showed panels prepared for the A. S. T. M. test of nickel-chromium *vs* copper-nickel-chromium on S. A. E. 1085 steel. Considerable discussion followed, and Mr. Sample answered many questions from the floor.

Two new members were initiated at this meeting.

Dick Wooley was elected the unanimous choice of the Branch as candidate for Third Vice-Presidency of the Society after Marcus Rynkofs had withdrawn his name.

George McDonald, *Secretary*

LOUISVILLE BRANCH

Mr. R. V. Vandenberg of the Alcoa Process Development Laboratory spoke about "Electroplating Aluminum Alloys" at the meeting on November 16.

Before plating, the original protective oxide film must be removed from the surface. Oxide films range in thickness from 10 to 120 Angstrom units. One method is to roughen the surface by mechanical or chemical means, but in most cases this results in an undesirable appearance and is not used widely for commercial purposes. The sodium zincate treatment for deposition of 0.0002–0.001 inch of zinc seems to be the best method of preparing aluminum for plating. The standard Rochelle salt copper strike is then applied, and the plater may proceed as he would handle most other types of metal. For a cleaner, Mr. Vandenberg recommended a 3 per cent each of sodium carbonate and trisodium phosphate. A 25 per cent sulfuric acid solution provides a suitable acid dip.

Mr. Vandenberg also discussed the anodizing of aluminum.

The next meeting will be held on January 18.

G. H. Hillebrand, *Secretary*

MELBOURNE BRANCH

The fifty-seventh regular meeting on October 19 was devoted to a question-and-answer session conducted by Librarian Hugh Teague. Over twenty questions submitted by members were discussed, many of which evoked considerable comment.

The question, "Can cadmium or zinc be used as an undercoat for nickel and chromium decorative work"? brought out that one large firm which is employing a zinc, copper flash, nickel, chromium plating cycle has proved to its own satisfaction that the zinc undercoat gives improved corrosion resistance. No one was able to suggest why a zinc undercoat, which would be much cheaper than copper, is not in general use.

"What pretreatment should be given to brass to ensure perfect adhesion of nickel"? was a question which caused even the quieter members to air their views. The general opinion was that a job should be prior cleaned and acid dipped, but one group favored a copper flash and slight etching of the copper bed fore nickel plating, and one plater claime good adhesion by cleaning the brass and immersing it in a weak solution of silver salts before plating.

Other subjects discussed were the purification of nickel solutions, pyrophosphate-copper plating, and belt polishing *vs* dressed rag wheels.

Acting President Bob Taylor announced that plans for the Annual Christmas Breakup have been completed. It will take the form of a dinner at the Hotel Federal, followed by an evening at the Tivoli Theatre.

Rowland H. Keller,
Assistant Secretary

MONTREAL BRANCH

Twenty-one members were present to hear Mr. William Starr of Lea Manufacturing Company, Waterbury, Conn., speak about "The Purchasing of Plating Supplies". Descriptions of purchasing agents as given by various administration personnel were followed by a resume of the many responsibilities of purchasing agents and many helpful suggestions pertaining to methods of handling inventories and setting minimum standards for each commodity. The many ways in which money could be saved by wise buying were explained. Reference was made to a code of ethics for purchasing agents which, if lived up to, would make life easier for vendors. Reasons were given for the current shortage of materials and how it can be alleviated to some extent. A discussion period followed.

J. D. Fairbairn was elected to the Board of Managers *vice* G. Morrisette, who has been suspended. J. G. Carrique, Banquet Chairman, gave a report on the banquet held in October. Three applicants were elected to membership.

The Branch will investigate the possibilities of holding a two-day convention in September, 1951.

William Glover, *Secretary*

NEWARK BRANCH

The regular meeting on October 20, with about sixty-five members and guests in attendance, began with the showing of two movie shorts: "Plating of Jewelry", sponsored by the MacDermid, Inc., and "Effect of Temperature and Concentration on Chemical Reaction Speed".

A short talk by Zachary Irenas on the subject of phosphatizing of steel gave the educational session a good start. The main attraction of the evening was the paper on "Chemical Disposition of Silver on Non-Conductive Bodies", by Dr. J. T. Owen of Merck and Company, Rahway, N. J. This paper will be published in Plating. A fine display of commercial novelties finished by the spray process, in which The J. L. Sommers Company of Newark collaborated, occupied a prominent place on the speaker's rostrum. All persons present received silver-sprayed toys as compliments of Mr. Horace Harding and his associates. Many questions were asked after the presentation of the paper, which Dr. Owen answered in amicable fashion.

During the business session which followed two applicants were elected to membership and six new applications were received. There were two reinstatements and one in-transfer.

The Board of Managers reported action on Mrs. Preston's request to set up a Paper Award as a memorial to her late father, Charles H. Proctor, Founder of the A. E. S. and the Newark Branch. President Diggin appointed a committee consisting of E. Bowerman, Z. Irenas, H. Smith, M. Diggin and G. Wagner to decide on the mechanism of this award of $100.00 per annum. He also appointed S. Barr, F. Lowenheim, C. Struyk, G. Foulke, and M. Diggin to serve as representatives on the Council of the Technical Societies, Inc.

John L. DeVries, Co-chairman of the Christmas Party, gave a brief report on the progress made by his committee.

Samuel S. Frey,
Recording Secretary

NEW HAVEN BRANCH

The Branch inaugurated a new type of educational session at its opening meeting on September 12. These sessions are designed to serve as an introductory course in plating for beginners and as a refresher course for old timers.

Technical Chairman Larry Durney introduced Dr. Walter R. Meyer, President of Enthone, Inc., and a recognized authority in the finishing field, whose subject was "Cleaning and Preparation of Metals for Electroplating".

This presentation was followed by a discussion period among the platers and representatives of major cleaner suppliers which provided many answers to the plater's cleaning problems.

B. J. Gaffney, *Secretary-Treasurer*

NEW HAVEN BRANCH

President Malcolm Orr opened the meeting on October 10 by having the members keep a minute of silence in honor of the late Robert T. Sammit, Branch Vice-President, whose sudden death was a shock to his many friends.

After John Martin of Enthone, Inc., had given brief summaries of interesting

finishing abstracts appearing in various journals, MR. LARRY DURNEY, Superintendent of Finishing, Sargent & Company continued the new type of educational program by discussing "Pickling and Bright Dipping of Metals Prior to Plating". His black-board talk included the advantages and disadvantages of sulfuric, hydrochloric, hydrofluoric and phosphoric acids, the various inhibitors and surface-active agents that can be used, and hydrogen embrittlement. A lengthy discussion period followed, which had to be terminated by Technical Chairman MALCOLM ORR due to the lateness of the hour.

B. J. GAFFNEY, *Secretary-Treasurer*

NEW YORK BRANCH

At the business meeting on October 13 five applications for membership and one new member were received. ANGELO AMATORE was appointed Chairman of the 1951 Banquet Committee. ALEXANDER BRAUN, speaking for the Board of Managers, reported that the financial records of the previous Secretary-Treasurer had been examined and found to be in good order. An assessment was voted levied on each member to aid in meeting the rising cost of running the Branch.

After a film on the production of nickel anodes had been shown, the meeting was adjourned.

The regular order of business was suspended at the meeting of October 27 in order that more time be available for the educational program.

Following a showing of a film on the mining of tin in Bolivia, the speaker of the evening, DR. FREDERICK LOWENHEIM of Metal & Thermit Corporation gave an excellent lecture on the plating of tin from alkaline baths and the plating of tin-zinc alloys. Refreshments were served at the close of the meeting.

GRACE ARONSON, *Recording Secretary*

PHILADELPHIA BRANCH

The October meeting, on the 27th, was held jointly with the Philadelphia Chapter of the American Society for Metals at the Engineers Club, with more than 200 attending. A buffet supper at 6:30 and a performance of magic by A. S. M. member PHIL PERMAR preceded the formal meeting at 8:00 P. M.

CHAIRMAN JACKSON of the Philadelphia Chapter A. S. M. opened the meeting and introduced PRESIDENT SAMUEL HEIMAN of the Philadelphia Branch, who spoke briefly on the relationship of A. S. M. and A. E. S. and of the activities in the electroplating field that are of direct interest to A. S. M. members. He cited electropolishing as a machining method where conventional means do not serve; casting of metals by electroforming; electrodeposition of alloys, such as silver-lead bearing liners, requiring no heat treatment or after-machining; surface hardening by means of chromium plating; and

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salvaging of worn or undersized parts by heavy plating and machining. He also spoke briefly of A. E. S. activities, including its Research Projects.

Moderator Joseph Mazia, A. E. S. and A. S. M. member, then introduced the featured speaker, Dr. Walter R. Meyer, of Enthone, Inc., who gave an excellent illustrated talk about "Metallurgical Aspects of Electrodeposited Coatings". He began with a discussion of the theory of adhesion, the forces involved and the interference by oxide coatings. The structure of acid copper deposits over buffed and etched surfaces was shown, the former assuming its own characteristic structure, the latter continuing the structure of the base. It was stated that no adhesive bond is stronger than the tensile strength of the weakest metal, coating or base. Hardness, hydrogen embrittlement, and fatigue were discussed, as were the factors governing throwing power. The structure of galvanized coatings was described and illustrated. The effects of diffusion on adhesion of electrodeposits were illustrated with special attention to zinc-base diecastings.

Due to the nature of the meeting, Branch business was laid over to a business meeting held on November 9 by the officers, Board of Managers, and committee members.

I. Wm. Marcovitch, *Secretary*

PHILADELPHIA BRANCH

The Annual Educational Session and Banquet was held in Hotel Broadwood, November 18. The Educational Session in the Forest Room began at 2:25 P. M. with approximately 100 members and guests in attendance. After expressing his appreciation for the work done by the 1950 Banquet Committee, the President, Dr. S. Heiman, introduced some guests from out-of-town: Horace Smith, George Wagner and Myron Diggin of the Newark Branch and Al Braun of the New York Branch. Guests were also present from Baltimore-Washington, Lancaster and Allentown-Reading Branches. The meeting was then turned over to Joseph Mazia, who presided in a very able manner.

The first speaker was Dr. William Blum, National Bureau of Standards, whose topic was "The Effects of War on the Electroplating Industry". He surveyed the World War II roles of plating metals: use of nickel for engineering purposes, as for electroforming of tubing; zinc plating on steel to replace parts made of brass and for corrosion protection (the zinc plated pennies in 1943 saved five million pounds of copper); extremely limited use of cadmium due to its scarcity; increased use of chromium for engineering purposes; gold and silver on radar parts and silver on steel tableware; increased use of electrolytic tin plate because of scarity of tin.

Of the metals consumed in the United States in 1948, 50 per cent of the cadmium, 15 per cent of the tin, 16 per cent of the nickel, 10 per cent of the silver, and 2 per cent of the zinc were used in plating. These figures illustrate the difficulty of substitution. The use of nickel for plating had risen from 7 per cent of the total (3,500 out of 52,000 tons) in 1940 to 22 per cent of the total in 1949 (15,000 out of 68,000 tons). These data illustrate the difficulty of maintaining an adequate supply of nickel with the increased use for plating and other purposes. The automobile industry used 62 per cent, the electrical-appliance industry 7 per cent of the plating nickel.

Dr. Blum called attention to the constant depletion of our metal resources and the necessity for conserving them. We may expect increased stockpiling; inventory-control orders limiting the amount of metals kept in stock; military priorities, with the military taking what they need through Defense Orders (D. O.); Government rationing of nickel and cobalt. Aluminum and copper are already rationed.

As to what to do, Dr. Blum suggested: (1) Get D. O. orders; (2) conserve critical metals by plating fewer parts, smaller areas, and where possible to lesser thickness. It would be a big mistake for the plating industry hastily to cut quality, or thickness, of plating, because very thin deposits may be a complete waste. It is better to encourage use of inferior substitutes, e. g., plastics for metals, than to produce an inferior plating job. Plating will not be shelved, nor pampered, but changes will be necessary to meet the present emergency.

Mr. R. O. Hull of R. O. Hull & Company, who spoke about "New Ideas in Plating and Control", suggested the following conservation measures: use of lower-metal-content cadmium solution, 1.5 oz/gal; reduction of chromic acid content in a chromium plating bath to 25 oz/gal to save dragout; reduction of nickel sulfate content to 25 oz/gal in bright-nickel solutions (with some sacrifice in plating speed); addition of nickel sulfate to the solution when nickel anodes get short and of zinc oxide to a zinc solution in the absence of zinc anodes.

A series of colored slides illustrated Hull Cell panel tests with various plating solutions of differing composition and contaminant concentrations. Under "new ideas", Mr. Hull mentioned new methods of stripping copper from steel; the use of Woods' high-chloride nickel solution instead of cyanide copper for striking; the addition of small amounts (0.01–0.02 oz/gal) of sodium hydrosulfite to improve the color of bright copper and minimize blistering; improvements in rinsing to prevent staining of brass; a new cadmium black for the Air Force; and an antifoaming agent to prevent explosions in zinc plating and cleaning solutions. He described briefly and passed around specimens of a hard, bright, tarnish-resistant speculum deposit, not yet released by Battelle Memorial Institute, which contains 40–50 per cent copper, balance tin. It is plated from an alkaline stannous bath which is unaffected by stannic tin.

The third speaker, Mr. Arthur W. Logozzo, President of Nutmeg Chrome Corporation and Past President of the A. E. S., spoke about "Hard Chrome Problems". Mt. Logozzo's opening remark, "Too much work has been done in the exploitation of hard chrome and too little done in exploration", is worthy of direct quotation. Slides illustrated the effect of the basis metal structure on the structure of the deposit. Data were presented on the cleaning and etching of various steels prior to hard-chromium plating, etching being essential for uniform structures. The use of sheet-lead shielding (0.004 inch thick sheet is widely used) next to high points and lacquer or plastic (polyethylene) sheeting for stopping-off low points eliminates build-up on corners. Light tin or chromium deposits serve to protect highly finished areas not being plated.

The following cycle for small tools was given: (1) Stress relieve at 600° to 1200° F (check with metallurgist for proper temperature); (2) clean anodically and rinse; (3) dip in 50 per cent HCl with addition agent; (4) rinse thoroughly; (5) deposit uniformly bright chromium with no frosted areas (5 minute average time, sometimes as little as 1½ minutes, for new tools); (6) bake at 350° F for 1–3 hours (30 minutes required at temperature).

Slides were shown giving practical racking and masking methods for 0.00002-0.00003 inch chromium on scissor blades. A new color film made by Mr. Logozzo contained a wealth of practical information and impressed the viewer with the painstaking care taken in racking, masking, and chromium plating.

A general question period followed, after which a rising vote of thanks was given to the speakers and to Mr. William Miller, Engineer of Philadelphia Rust Proof Company, who operated the slide and motion-picture projectors.

The Banquet in the Crystal Ballroom started at 7:00 with 260 attending. An excellent turkey dinner was served and many beautiful and valuable door prizes were distributed. This was followed by a top-notch floor show and dancing.

The Branch extends its sincere thanks to all who by their generous support contributed to the success of the affair.

I. Wm. Marcovitch, *Secretary*

PROVIDENCE-ATTLEBORO BRANCH

A business meeting was held on August 21 to explore the program for the coming year: continuation of the sponsored Electroplating course at the Extension Division of the R. I. State College, topics

for the regular meetings, Christmas Party, and delinquent members.

The possible affiliation with the Providence Engineering Society was also discussed. This move would give us several advantages, such as a better meeting place, parking facilities, movie projectors and slide camera. It would also give us access to all technical meetings held in the hall.

The first regular meeting of the season was held on September 18. A movie showed the making of jewelry from the casting through all operations, including plating. DR. PARKER was presented with a Past President's pin. It was voted to change meeting place to the Engineering Society Hall. If accepted by the Providence Engineering Society, the change will probably take place the first of next year.

FRANK W. BOOTHROYD, *Secretary*

ROCHESTER BRANCH

On November 20, thirty members and guests met at the Rochester Institute of Technology to transact business, elect a new member, and hear MR. E. VON HONDACH of the Carpenter Steel Company speak on the finishing of stainless steels. His talk, stressing the use of electrolytic polishing for intricately shaped parts rather than flat surfaces, the need for passivation following any process in which the surface had been activated, and the importance of avoiding buffing compounds containing iron oxides, was graphically illustrated by many specimens.

We hope to stir up increased interest in our work on the part of local manufacturing concerns.

WALTER F. SWANTON, *Secretary*

SAGINAW VALLEY BRANCH

A regular dinner meeting was held on November 8 in the Zehnder Hotel, Frankenmuth, Mich. Forty-three members and guests attended.

MR. P. N. BURKARD, Director of Technical Service, J. B. Ford Division, Wyandotte Chemical Corporation, gave a blackboard presentation of "The Story Behind Metal Cleaning".

At a board meeting held immediately following the session, progress of plans for the "Ladies' Night" on Saturday, February 10, were discussed.

WILMAR W. KAUFMANN,
Recording Secretary

ST. JOSEPH VALLEY BRANCH

The first regular meeting of the 1950 Fall session was held in Hotel Elkhart, Elkhart, Inc., on October 4. Twenty-five members and guests attended the dinner, and thirty-three were present for the technical session.

Two applications for membership were received.

FIRST VICE-PRESIDENT VICTOR E. PETERSON, having accepted a position in Reed City, Mich., resigned his office. SECOND VICE-PRESIDENT RICHARD C. LOCKERBIE therefore assumed the office of First Vice-President, JOHN C. BAYMAN of the Board of Managers assumed the office of Second Vice-President, and DAVID A. LE FEVRE was appointed to fill the vacancy on the Board of Managers during Mr. Bayman's one-year term.

The members expressed concern that such scarce items as nickel anodes, cadmium, etc., can be bought in almost any amount at exorbitant prices whereas the regular suppliers are unable to take care of their minimum needs. The Branch will try through the Society to get the powers that be to crack down on this situation.

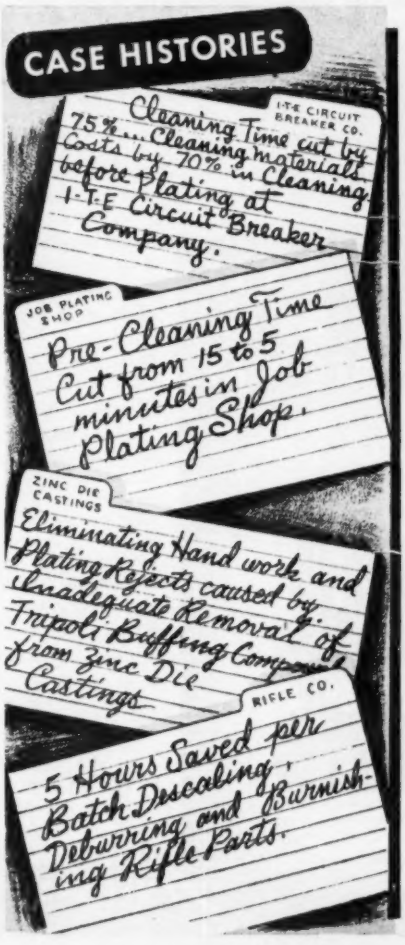
LIBRARIAN DR. ERNEST WILHELM introduced MR. FRANK K. SAVAGE, an old friend of the Branch who years ago presented it with its charter. In the course of his talk on "Plating Room Instrumentation" he mentioned the instruments with which the practical plater is familiar, and indicated both their usual applications and many others in which they can assist the plater in making operations more foolproof or less expensive. He then recommended practical and relatively inexpensive methods of installation of level controls, generator bells, and automatic *p*H controls. A discussion period followed.

EUGENE ROTH, *Secretary-Treasurer*

ST. JOSEPH VALLEY BRANCH

Twenty-five members and guests were present for the dinner and thirty-six attended the technical session on November 1.

Two applicants were elected to membership in the Society. Correspondence with A. E. S. PRESIDENT NEILL relative to scarce items sold at exorbitant prices was read. MR. CLYDE KELLY of Chicago, a member of A. E. S. Research Committee, spoke of the need for additional sustaining memberships to carry out the Society's Research program.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Cleaning Time cut by 75%... Cleaning materials costs by 70% in Cleaning before Plating at I-T-E Circuit Breaker Company.
JOB PLATING SHOP
Pre-Cleaning Time Cut from 15 to 5 minutes in Job Plating Shop.
ZINC DIE CASTINGS
Eliminating Hand work and Plating Rejects caused by inadequate Removal of Tripoli Buffing Compound from Zinc Die Castings
RIFLE CO.
5 Hours Saved per Batch Descaling, Deburring and Burnishing Rifle Parts.

You, Too, Can Cut Costs and Improve Cleaning with Magnus Materials Methods and Machines

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For information, write Magnus Chemical Company, 41 South Ave., Garwood, N. J. In Canada—Magnus Chemicals, Ltd., Montreal. Service representatives in principal U. S. cities.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 64.

DR. ERNEST WILHELM then introduced the guest speaker, MR. F. J. KOLAR, of Western Electric Research and Development Staff. Mr. Kolar's topic, "Zinc Plating", had particular reference to the zinc cyanide bath. Mr. Kolar recommended that platers discard some accepted ideas on the cyanide-zinc ratio control; that the use of addition agents for the zinc bath be discarded and that sulfide purifier be used instead; and that statistical control-chart methods be employed.

The excellent discussion period which followed brought out that Western Electric does not use salt-spray tests because they could not be duplicated consistently; humidity tests, with which good results have been had, are used instead. The usual plating thicknesses at Western Electric for zinc castings are 0.0002 inch min for indoor exposure, 0.0005 inch min for concealed outdoor exposure, and 0.002 inch for direct outdoor exposure.

Types of zinc anodes were also discussed, including the use of zinc-base diecastings when pure zinc anodes are not available.

EUGENE ROTH, *Secretary-Treasurer*

SPRINGFIELD BRANCH

A portion of the meeting on May 22, attended by fifteen members, was devoted to a discussion of how to create greater local interest in the Society, larger membership, and increased meeting attendance. GEORGE B. HOGABOOM outlined the methods successfully used by the Hartford and Waterbury Branches, namely, elimination of business from monthly meetings, letting the officers handle it; having question periods or resumes of recent developments and movies at each meeting; having two or more nontechnical meetings—ladies' night, dance, Christmas party, picnic—each year; following each meeting by a social hour financed by a supply house.

The technical session consisted of a question period handled by George A. Hogaboom in his usual fine fashion. (1) Ease of removal of buffing compounds by cleaners depends on its nature. Present trend is toward lower buffing speed and lower-melting-point compounds, which melt at lower bath temperatures. Compounds containing rancid tallow, which produces insoluble soaps in alkali cleaners, should be removed by solvent soaking. Emulsion cleaners are used prior to electrocleaning, but all traces of emulsion must be removed to prevent formation of insolubles on the work in subsequent electrocleaning. (2) Thickness of anodic films on aluminum can be measured by the A. S. T. M. electric-resistance method. (3) Use Wood's all-chloride nickel solution to activate passive nickel. It is preferred to chromium plating at low voltage for at least 2 minutes and gradual increase to operating voltage. (4) For descaling of brass use 8 per cent sulfuric acid (never more than 10 per cent) and a small amount of bichromate. For bright dipping use 1 part of each sulfuric acid, nitric acid and water, with small amount of hydrochloric acid. The hydrochloric acid requirement increases in the following order: low brass, high brass, leaded brass, nickel silver. Best wetting and most uniform etch is had if parts are taken directly from the hot alkali cleaner into the acid.

P. W. PROUTY, *Secretary*

TWIN CITY BRANCH

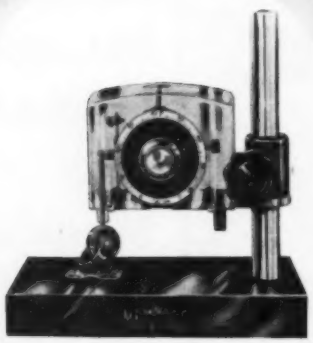
The Twin City Branch met on Novembe 6 in the Evergreen Room of the Hotel Curtis, Minneapolis, with forty-two persons present.

Following dinner, PRESIDENT AL JOYNER introduced guests and new members and conducted the business meeting.

LIBRARIAN PAUL HESSE introduced as the speaker of the meeting MR. HUBERT GOLDMAN of Enthone, Inc., New Haven, Conn. Speaking on the subject, "The Plating, Bright Dipping and Finishing of Aluminum", Mr. Goldman gave one of the most interesting discussions presented before the Branch. He was presented with a gift from the Branch following his talk.

ROBERT L. BUCKLEY,
Secretary-Treasurer

MEASURE THICKNESS OF COATINGS ON METALS THE EASY, ACCURATE WAY



Amico Brenner MAGNE-GAGE

FOR MEASURING THICKNESS OF NON-MAGNETIC COATINGS ON IRON OR STEEL AND NICKEL COATINGS ON IRON, STEEL, OR ANY NON-MAGNETIC MATERIAL

The Magne-Gage is a versatile, easy-to-use instrument for accurately measuring coatings on convex, concave, or plane surfaces, without destroying either the coating being measured or the base material. Modified Magne-Gages can be supplied to measure coatings on inside surfaces of tubes, pipes, etc. Less than 45 seconds are required to take a reading, and an accuracy of better than 10% full-scale is assured. Operation is based on the magnetic attraction of a permanent magnet to the material being measured and/or its backing, thus no electrical circuits are involved and no auxiliary equipment is required.

A special Magne-Gage is available for measuring composite copper-nickel coatings on steel.

SEND FOR FREE BULLETIN NO. V -2150, DESCRIBING THE MAGNE-GAGE AND OTHER COATING THICKNESS GAGES

Coating on Cylindrical Object Being Measured with the Magne-Gage

AMERICAN INSTRUMENT CO., INC.
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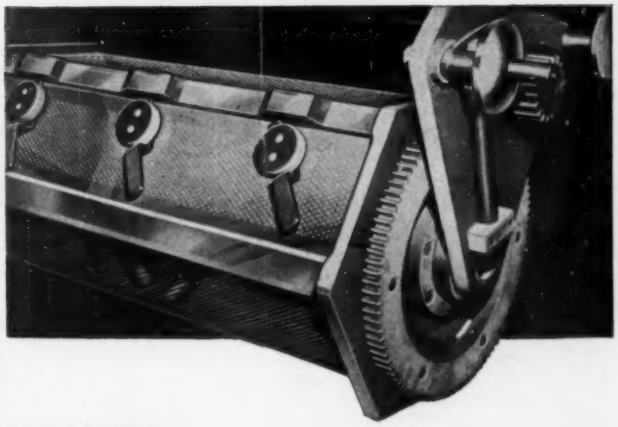
ONE LOADING

for Complete Cleaning and Plating Cycles



in the NEW BELKE High Temperature LUCITE BARRELS

No more transferring work from barrel to barrel. You load the work once for the whole job — pickling, electro-cleaning, plating and rinsing.

Withstand All Solutions — Give long service in cadmium, nickel, copper, zinc, tin and brass plating cycles *at temperatures to 185°F.*

Molded One-Piece Construction — No panels, ribs or tie rods. No trapping of small pieces to cause rejects and unloading trouble. Faster plating and better quality.

Built for Long Service — Door opening in cylinder reinforced at top and bottom and braced across center for greater strength and to prevent warping. Hangers, gears and bearings of Melamine — No metal exposed to solution except easily replaceable ball contacts.

Other Service-Proved Features

Tight fitting covers with convenient cover locks attached.

Extra capacity, straight line current conductors.

Improved flexible dangler contacts.

Double duty bearings on drive shaft.

Replaceable bushings for long life with low upkeep.

To modernize your plating barrels, BELKE High Temperature Lucite Cylinders can be furnished for any size and style of hanger.

Consult your BELKE Service Engineer for complete information — or write.

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947 N. Cicero Ave.
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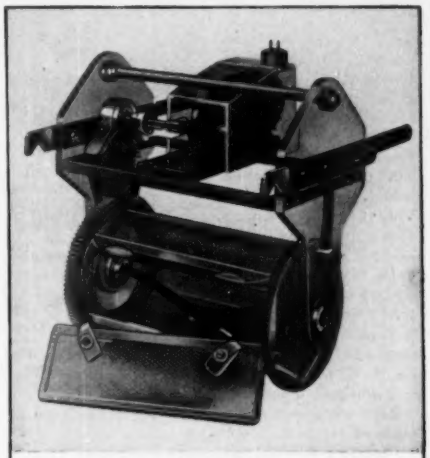
EVERYTHING FOR PLATING PLANTS



BELKE PORTO-PLATER

For Small Odd Jobs

Sets into any still plating tank. Easily transferred by hand — weight only 27 lbs. Capacity is approximately 2 quarts. Molded High Temperature Lucite Construction withstands all cleaning and plating cycles at temperatures to 185°F.

Fast and easy loading and unloading is afforded by clutch that starts and stops cylinder without shutting off motor.

Support arms of Porto-Plater rest across bus rods so cylinder hangs down into plating solution. Uninsulated notched end of support arms contact cathode rod to complete plating circuit. Operated by complete self-contained motor drive with plug connection.

For complete information, consult your BELKE Service Engineer — or write.

THE LOS ANGELES BRANCH*

Host to the A. E. S. Convention June 25-28, 1951

The Los Angeles Branch was founded twenty years ago as the result of the gentle prodding by a group of migrants from various eastern Branches. These were: Frank C. Ruston (St. Louis); Clarence E. Thornton (Chicago); Joseph Ellis (Toronto); John Merigold (New York); Robert Gibson (St. Louis); and Joseph Corbett (Pittsburgh).

The local foreman platers and shop owners who banded together to secure the first temporary charter were: C. A. Russill, E. W. Francis, A. J. Brannon, Ben Foss, Lewis Blaisdell, E. P. Robinson, Phillip M. Virtue, J. H. Weaver, Earl Coffin, Ray Vasquez, O. S. Pendlay, M. D. Rynkofs, George W. Kyle, Martin H. Brooks, B. C. Gardes, Charles R. Howe, E. D. Bedwell, Don M. Bedwell, J. R. Delaney, M. McNulty, J. A. Kirsoe, E. D. Martin, Robert U. Gripp, E. A. Savory, and Harold Coombs.

First Meetings and Officers

A preliminary meeting was held on January 7, 1929, at the Elite Catering Company, 633 Flower Street, and the following officers were chosen: Robert Gripp, President; D. M. Bedwell, Vice-President; M. D. Ryakofs, Secretary-Treasurer; C. A. Russill, Librarian; J. Jacques, Sergeant-at-Arms; E. W. Francis, H. H. Dimmitt, and Frank C. Rushton, Board of Managers.

Application for a charter was made at the next meeting, on February 4, 1929, at the Y. M. C. A., 715 S. Hope Street. About this time Bob Gripp moved back east and Clarence Thornton replaced him as president. A permanent charter was granted to the Branch in September, 1929.

Growth of the Branch

The growth of the Branch from a membership standpoint was rapid. It was the sixteenth Branch to be chartered, but in October, 1929 it was ninth in size with sixty members and in 1931 fifth in size, a position which it still holds.

Despite membership drives and regular short pep talks at the meetings the membership count dropped off during 1933 and 1934 because of National economic conditions. With the war and the rapid industrial expansion of the Los Angeles area, the Branch grew rapidly. Starting with a membership of fifty-nine in May, 1940, the Branch had more than doubled in size by May, 1941, and twice, in 1940–1941 and 1944–1945, it won the trophy for largest percentage increase. Membership as of the present writing is 202.

Geographically the Branch has spread almost to the Los Angeles city limits. J. C. Hardy of Honolulu became a member of the Los Angeles Branch in 1935, and other members are located in Vancouver, B. C.; Spokane, Wash.; San Antonio, Texas; Denver, Colo.; Kansas City, Mo.; Portland, Ore.; and Massachusetts.

Please reserve accommodations as checked (√) below:

Name _____
(Please Print)

Address _____

City _____ State _____

Unless requested otherwise, we will hold your reservation until 6 p. m. of the day of your arrival.

Date Arriving _____ Hour _____ A.M. P.M.

Date Departing _____ Hour _____ A.M. P.M.

Room with Bath	$ 7.50 ☐	$10.50 ☐
Double Bed	$ 8.50 ☐	$12.50 ☐
Single or Double—Per Day	$ 9.50 ☐	
Twin-Bed Room with Bath	$ 9.50 ☐	$12.00 ☐
	$10.50 ☐	$12.50 ☐
Single or Double—Per Day	$11.50 ☐	$13.50 ☐

More Than Two Persons in One Room
For each additional person, extra charge is $2.50 per day

SUITE—Living Room, Bed Room and Bath
For One or Two—$18 ☐ $24 ☐ $30 ☐

If a room at the rate requested is unavailable, one at nearest available rate will be reserved.

AMERICAN ELECTROPLATERS' SOCIETY

June 24, 25, 26, 27, 28, 29, 1951
The Biltmore Hotel, Los Angeles
Please place card in envelope and mail to
Herold J. Kroesche, The Harshaw Chemical Co.
609 S. Grand Ave., Los Angeles 14, Calif.

Root of Other Branches

Even as the Branch was formed through the efforts of A. E. S. members from other Branches, so it, in turn, has assisted in the founding of other Branches. Joseph Levoy was instrumental in founding the San Francisco Branch in 1931. E. J. Wright, recent President of the Sydney Branch, became a member of the Branch in 1932 and was the first of approximately two dozen Australian electroplaters to join the Los Angeles Branch. In 1944, the Australian members withdrew to establish the Adelaide, Sydney and Melbourne Branches which since have exhibited a remarkable growth.

Educational and Social Functions

The monthly meetings of the Branch feature a speaker discussing some phase of electroplating, generally both its technical and practical aspects. The formal talk is followed by an informal question-and-answer period, during which individuals can cite their problems and draw on the collective experience and knowledge of the group for assistance.

The Branch has published three handbooks, in 1930, 1945, and 1949. As indicated in the editor's forewords, they do not pretend to be complete treatises on the science and art of electroplating but compilations of information that may be of value to people in the plating industry on the Pacific Coast.

During its early years the Branch sponsored courses in the

(*Continued on page 95*)

*This story about the Los Angeles Branch was prepared by Dean D. Williams, a member of the Branch.

Flexible and More Precise

THAN WITH HARD BURRS

Do cast or stamped parts you are finishing come to you with slivers, fins, rough edges, plugged holes, imperfect corners?

Look into the Lea Burring Method for fast and precise removal of such excess metal and straightening out of edges and surfaces. This method while used to some extent prior to World War II really came into its own when manufacturers were faced with really stiff specifications and close tolerances. The Lea Method helped many a company stay in war-contract business.

Since the war many companies retained the Lea Method of Burring in order to maintain high finishing standards. Now, there is an increasing demand for better preparation of surfaces on which finishing operations are to be performed. Now—as before—Lea is the method being adopted for removing burrs.

Our technical staff will be glad to help you make use of this proved method. Write in detail and, if possible, send us samples of pieces to be deburred for our recommendations.

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions

THE LEA MANUFACTURING CO.
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370 Victoria Street, Toronto 2, Canada

Manufacturers of Lea Compound and Learok, Industry's Quality Buffing Compounds for over Twenty-Five Years

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 67.

Membership Report of the A. E. S.

Elections

BOSTON BRANCH: Eugene M. Pfingston, Joseph F. Wenckus

BRIDGEPORT BRANCH: Milton Gellis, Paul R. Jarvi, Nicholas Sedelnik

CHICAGO BRANCH: Harold Bach, Jerry Havlik, J. C. Juneau, Jr., William A. Rowles, George M. Schnaufer, Leroy T. Schubert, Andy Seligman, George F. Tintra, Edward Wardzala

CINCINNATI BRANCH: Charles R. Sorber

DAYTON BRANCH: Harry F. Allen

DETROIT BRANCH: H. V. Gervais, N. Novikoff, W. H. Schan, F. K. Scott, N. E. Sullivan, P. J. Suriano, E. Van Zandt

HARTFORD BRANCH: Joseph Ciarcia

LANCASTER BRANCH: Peter Edmund

LOS ANGELES BRANCH: Ernie Bustamante, Albert S. Ibanez, Harry K. Lieb, David L. Merrill, Walter Plummer, Elmer M. Sanders

LOUISVILLE BRANCH: Omer E. Burnett

MELBOURNE BRANCH: S. M. Anderson, R. M. Bailey, J. T. Chappel

MILWAUKEE BRANCH: Leonard B. Bruch, Wayne G. Dickinson, Arwin G. Piepenhagen, Jacob Vogel

MONTREAL BRANCH: Charles C. Claridge, W. J. Douglas Jaffrey, John A. Thomas

NEW HAVEN BRANCH: George J. Berky, Francis E. Jones

NEW YORK BRANCH: Nicholas Ananiatis, Blase Cosentino, Irving I. Greene, Arthur Holland, Murray Paley, Roy Yasen

PHILADELPHIA BRANCH: Lenard R. Abbott, Benjamin Barnes, Martin H. Brill, Attilio Gentile, Stephen J. Hallo, Frank J. Kross, Fred C. Martin, Leonard Mudrick, Louis R. Reckner, William J. Robinson, Joseph A. Teti, Jr.

ROCHESTER BRANCH: Ray Northrup

SAGINAW VALLEY BRANCH: Charles E. Johnson, Joseph A. Matsko, Arthur J. Medwedeff

SYDNEY BRANCH: Auguste T. Buda, Arthur H. Goyle

SYRACUSE BRANCH: Louis P. Braemer, Charles J. Curran, Charles W. Le

Membership Competition

	Membership April 1, 1950	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
GRAND RAPIDS	141	6	+17½	+12.4
DETROIT†	483	46	+41	+ 8.5
NEW YORK	280	20	+21	+ 7.5
CHICAGO	372	34	+23½	+ 6.3
MILWAUKEE	124	17	+ 5½	+ 4.4
BOSTON	142	15	+ 5	+ 3.5
TORONTO	124	7	+ 3½	+ 2.8
WATERBURY	125	8	+ 3	+ 2.4
BRIDGEPORT	155	7	+ 2	+ 1.3
PITTSBURGH	142	2	+ 1½	+ 1.1
HARTFORD	132	6	+ 1	+ 0.8
PHILADELPHIA	192	19	+ ½	+ 0.3
LOS ANGELES	201	24	+ ½	+ 0.2
CLEVELAND	195	22	− 6½	− 3.3
NEWARK	238	4	−10½	− 4.4
SECOND GROUP				
MELBOURNE†	111	18	+10	+ 9.0
MONTREAL	68	9	+ 5	+ 7.4
CINCINNATI	87	5	+ 3½	+ 4.0
INDIANAPOLIS	97	9	+ 2½	+ 2.6
ST. LOUIS	97	9	+ 2½	+ 2.6
NEW HAVEN	106	10	+ 1½	+ 1.4
BALTIMORE-WASH.	85	7	− 1½	− 1.8
BUFFALO	77	1	− 3	− 3.9
DAYTON	97	1	− 4½	− 4.6
SYRACUSE	85	12	− 4	− 4.7
ADELAIDE	72	4	− 6	− 8.3
PROV.-ATTLEBORO	112	3	−12	−10.7
TWIN CITY	71	..	− 8	−11.3
SYDNEY	109	7	−13	−11.9
ROCHESTER	104	8	−16	−15.4
THIRD GROUP				
ROCKFORD	64	9	+ 9	+14.1
ALLENTOWN-READING	37	6	+ 5	+13.5
COLUMBUS	47	3	+ 4½	+ 9.6
ST. JOSEPH VALLEY	66	8	+ 4	+ 6.1
HAMILTON	23	1	+ 1	+ 4.3
SPRINGFIELD	51	1	+ ½	+ 1.0
WESTERN ONTARIO	23	..	.....	.....
LANCASTER	62	2	− 4	− 6.4
SOUTHEASTERN†	54	3	− 5	− 9.2
TOLEDO	49	3	− 5	−10.2
JACKSON-LANSING	57	..	− 7½	−13.1
SAN FRANCISCO	66	10	− 9	−13.6
LOUISVILLE	25	1	− 3½	−14.0
SAGINAW VALLEY	64	4	− 9	−14.1
OUTSIDE COMPETITION				
AT LARGE	104	21	+11	.....
IN TRANSFER	27	..	− 2	.....
TOTAL A. E. S.	5,236	415	+49	+ 0.9

Active Membership, December 1, 1950 5,285

*Subject to correction. †Winners of membership competition in 1949–1950.

Roy, Charles Manaseri, Theodore L. McGinn, Jr.

TOLEDO BRANCH: Jack H. Fries

TORONTO BRANCH: John Summer

WATERBURY BRANCH: Joseph Fazi, Kenneth A. Moody, William J. Zubrisky

MEMBERSHIP-AT-LARGE: George H. Maze

Reinstatements

BALTIMORE-WASHINGTON BRANCH: James E. Bobsack, Maurice Caplan, Howard L. Wright

NEW HAVEN BRANCH: Ralph M. Sasso

TOLEDO BRANCH: Ronald Bechtel, James Lee, Charles Vannorsdall

MEMBERSHIP-AT-LARGE: Joaquin Agullo Marly

Transfers

Harold W. Faint to Chicago Branch; D. L. Taylor to Cincinnati Branch; William P. Foley from Detroit Branch; George Magurean from Detroit Branch; John C. Hampson from Indianapolis Branch; Samuel DeJack to Milwaukee Branch; John Kosmos to Springfield Branch; G. M. Kerr from Toronto Branch

Resignations

MELBOURNE BRANCH: G. M. Carter
SPRINGFIELD BRANCH: Edward T. Manley

Suspensions

BUFFALO BRANCH: R. M. Blake, R. Fischer, G. H. Fisk, H. G. Wall

CINCINNATI BRANCH: W. J. Ehlen, J. Fletcher Gordon, August Schwering

HARTFORD BRANCH: Albert H. Gerlach, Wilbur H. Lamie, I. M. Wolfson

MILWAUKEE BRANCH: Clarence F. Anderson

PHILADELPHIA BRANCH: A. H. Anderson, Joseph J. Baloga, Cuthbert C. Becker, Wayne Gaddy, David Halpert, Fred Mendola, Frank P. Smith, Samuel S. Smyth, George R. Spotts, Eugene E. Sullivan, William H. Wehmeyer, Walter Yoder

MEMBERSHIP-AT-LARGE: Sydney Bull

Deaths

LOS ANGELES BRANCH: Frank C. Rushton, C. G. Spence

PROVIDENCE-ATTLEBORO BRANCH: James L. Smith

WATERBURY BRANCH: Norman Tice

Convention News

(*Continued from page 92*)

Fundamentals of Chemistry for Platers, classes being conducted at Los Angeles and Polytechnic High Schools. At the present time member Mitchell Raskin is teaching a University of California extension course covering the science and practice of electroplating.

The big event of the year is the Annual Educational Session held about the third Saturday of March. It consists of an educational program from 10 A. M. to 4 P. M., at which four or five outstanding, nationally known speakers are presented. This is followed, in the evening, by a dinner-dance attended by the members, their wives and their friends.

As a matter of record, the first annual banquet was held at the Elite Catering Company, March 15, 1930, amidst heavy rain and hail. The second annual banquet was held at the Chamber of Commerce Building on March 14, 1931.

Though meetings are suspended during the summer months, it is not uncommon for the Branch to get together during the summer for a picnic. The first affair of this kind was held at Manhattan Beach on September 2, 1931. For the last two years, the picnic has been held at Ladera Park. It is usually highlighted by a softball game and a fat man's race. At the 1947 picnic an airplane crashed in the park killing three people, none of whom, fortunately, were platers.

Honorary Members

The A. E. S. has recognized two members of the Branch who have made outstanding contributions to the advancement of the Society by electing them to Honorary Membership: Ernest Lamoureux and Frank Rushton. Both are now deceased, Frank Rushton's obituary appearing elsewhere in this issue.

Present Leadership

As in the past, the Branch enjoys having a strong and capable leadership. It includes the following:

R. J. Wooley—President
Ray Lostutter—First Vice-President
M. H. Orbaugh—Second Vice-President
G. D. McDonald, Jr.—Secretary
Ernest Fest—Treasurer
Morton Schwarz—Librarian
Don Bedwell, Alan Sulzinger and Walter Behlendorf—Board of Managers

Working with an enthusiastic Convention Committee and having at their disposal the matchless facilities of Los Angeles and the Pacific Southwest, they assure every Convention visitor a successful meeting in June.

Hotel Reservations

The hotel-reservation card reprinted herewith will be sent to all A. E. S. members and to advertisers in Plating on or about February 1. It is suggested that reservations be made early.

Available for Immediate Shipment Attractive Values

THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS, WITH FULL CONTROL EQUIPMENT:

1—10,000/5000 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Separately Excited. Synchronous Motor. Excellent Condition.
1—6000 AMPERE, 2-6 VOLT, **JANTZ AND LEIST.** Separately Excited. Excellent Condition.
1—5000/2500 AMPERE, 6/12 VOLT, **EAGER ELECTRIC CO.** Separately Excited. Excellent Condition.
1—3000/1500 AMPERE, 12/24 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Synchronous Motor. Exciter-in-Head. Excellent Condition.
1—2000/1000 AMPERE, 6/12 VOLT, **A. P. MUNNING "OPTIMUS."** Excellent Condition.
1—1500/750 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE.** Excellent Condition.
1—1250 AMPERE, 15 VOLT, **COLUMBIA ELECTRIC CO.** Separately Excited. Ball Bearing Design. Practically New.
1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS CO.** Separately Excited. Excellent Condition.
2—1000/500 AMPERE, 6/12 VOLT, **CHARLES J. BOGUE.** Separately Excited. Interpole Design. Exciter-in-Head.
1—1500 AMPERE, 40 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Anodizing Unit. Complete Controls. Synchronous Motor. Excellent Condition.
1—1000 AMPERE, 40 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Anodizing Unit. Synchronous Motor Drive. Full Controls. Excellent Condition.
1—1000 AMPERE, 40 VOLT, **CHANDEYSSON ELECTRIC CO.** Anodizing Unit. Synchronous Motor Drive. Excellent Condition.
1—400 AMPERE, 40 VOLT **"M. G. C."** Anodizing Motor Generator Set. Exciter-in-Head.
1—1000 AMPERE, 25 VOLT **HANSON-VAN WINKLE-MUNNING CO.** Anodizing Unit. Separately Excited.
5—**GREEN SELECTROPLATERS,** 1800 AMPERES, 12 VOLTS, for operation on 220 volt, 3 phase, 60 cycle.
4—**GENERAL ELECTRIC COPPER OXIDE RECTIFIERS** 500 AMPERES, 6 VOLTS for operation on 220 volt, 3 phase, 60 cycle.
1—**GREEN SELECTROPLATERS,** 500 AMPERES, 6 VOLTS, for operation on 220 volt, 3 phase, 60 cycle, practically new.

SPECIAL

1—12,000/6000 AMPERE, 12/24 VOLT, BRAND NEW COLUMBIA. Separately Excited. Synchronous Motor. Complete Controls.

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IMMEDIATE SHIPMENT

M. E. BAKER CO.
25 WHEELER STREET
CAMBRIDGE, MASS.

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Branch Secretaries and Research Chairmen

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1341 Norton Avenue, Columbus 12, Ohio

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Ternstedt Division, G. M. C.
6307 W. Fort Street, Detroit 9, Mich.

Second Vice-President ..... F. J. MacSTOKER
Farrand Optical Company, Inc.
4401 Bronx Boulevard, Bronx, N. Y.

Third Vice-President ..... Dr. G. P. SWIFT
53 Galen Street, Watertown 72, Mass.

Past President ..... A. W. LOGOZZO
Nutmeg Chrome Corporation
79 Chapel Street, Hartford 3, Conn.

Executive Secretary ..... Dr. A. K. GRAHAM
P. O. Box 168, Jenkintown, Pa.

A. E. S. RESEARCH COMMITTEE

Chairman ..... Dr. W. A. WESLEY
The International Nickel Co., Inc., Bayonne, N. J.

Secretary ..... The Executive Secretary

LOCAL BRANCHES

ADELAIDE, AUSTRALIA meets second Wednesday of each month. Address G.P.O. Box 598E, Adelaide, S. A., Australia.

ALLENTOWN-READING meets third Wednesday of each month in Spurgeon's Hotel, Allentown, Pa. Secretary-Treasurer, James F. Riegel, 425 S. 18th Street, Allentown, Pa. Research Finance Committee Chairman, William R. Pfeiffer, Jr., 975 Green Street, Allentown, Pa.

BALTIMORE-WASHINGTON meets second Tuesday of each month with meetings in Baltimore at the Engineers' Club and in Washington, D. C., at the National Bureau of Standards. Secretary, George E. Best, c/o Mutual Chemical Company of America, 1348 Block Street, Baltimore 31, Md.

BOSTON meets first Thursday of each month in Hotel Statler. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown 72, Mass. Research Finance Committee Chairman, Eugene P. Carter, c/o United Carr Fastener Corporation, 81 Ames Street, Cambridge, Mass.

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BUFFALO meets first Friday of each month in Markeen Hotel. Secretary, T. Joseph Cuerdon, Jr., 263 Stevenson Boulevard, Buffalo 21, N. Y. Research Finance Committee Chairman, B. P. Fortrim, 200 Forest Drive, Orchard Park, N. Y.

CHICAGO meets second Friday of each month at 8 P. M. at Western Society of Engineers, 84 E. Randolph Street. Secretary-Treasurer, Paul Glab, 882 N. Paulina Street, Chicago, Ill. Research Finance Committee Chairman, Clyde Kelly, 740 W. Englewood, Chicago 21, Ill.

CINCINNATI meets fourth Wednesday of each month at 8 P. M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary-Treasurer, Charles Wise, c/o The Buckeye Products Company, 7020 Vine Street, Cincinnati 16, Ohio.

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GRAND RAPIDS meets second Friday of each month at 7:30 P. M. in Rowe Hotel. Secretary, Victor V. Ventoli, 225 Fountain Street, N. E., Grand Rapids, Mich. Research Finance Committee Chairman, John W. Putte, 308 Gladstone Avenue, S. E., Grand Rapids, Mich.

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INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 Washington Street. Secretary, Howard Phillips, 1024 Shelby Street, Indianapolis 3, Ind.

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LANCASTER meets second Friday of each month at 8 P. M. in Thaddeus Stevens Industrial School. Secretary-Treasurer, Harry A. Saylor, 40 N. Poplar Street, Elizabethtown, Pa. Research Finance Committee Chairman, Harry Hovis, Lincoln Highway, West Lancaster, Pa.

LOS ANGELES meets second Wednesday of each month at 6:30 P. M. in Rodger Young Auditorium. Secretary, G. D. McDonald, Jr., 3114 Purdue Avenue, Los Angeles 34, Calif. Research Finance Committee Chairman, Jack Beall, 1272 Inverness Drive, Pasadena, Calif.

LOUISVILLE meets third Thursday of each month in Room 119, Speed Scientific Building, University of Louisville. Temporary Secretary, Stanley J. Beyer, 1304 Barret, Louisville 4, Ky. Research Finance Committee Chairman, Garland Logsdon, 1519 Central Avenue, Louisville, Ky.

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WESTERN ONTARIO meets third Friday of each month in William Pitt Hotel, Chatham, Ontario. Secretary-Treasurer, K. W. Farguhar, c/o Wallaceburg Brass, Ltd., Wallaceburg, Ontario, Canada.

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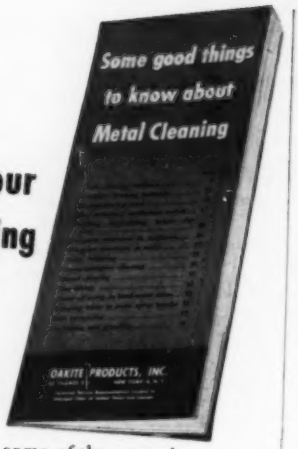

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AMERICAN SOCIETY FOR TESTING MATERIALS Spring Meeting and Committee Week in Cincinnati, Ohio, on March 5–9.

CONFERENCE ON INDUSTRIAL PERSONNEL at Columbia University, Department of Industrial Engineering, New York City, on March 19–23.

BOSTON BRANCH, A. E. S. Annual Technical Session and Banquet in Hotel Statler, Boston, Mass., on April 7.

FOURTH NATIONAL MATERIALS HANDLING EXPOSITION AND CONFERENCE in International Amphitheatre, Chicago, Ill., on April 30–May 4.

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